

**[RE] MEASURING [LEED] SUSTAINABILITY:
FROM A GLOBAL RATING SYSTEM TO TROPICAL SPECIFICITY**

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Dedication

In loving memory of my grandfather *Casito*, his motivation and the promise I made to finish this PhD, gave me the strength to keep going.

To my son, Christian, to teach him that with patience, perseverance and hard work, goals can be achieved.

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Abstract

This research explores the applicability of the LEED certification system in regions/contexts different to those initially designed for. The topic is explored via the case study of Puerto Rico (P.R.), a United States (U.S.) Commonwealth island in the Caribbean, where LEED has become widely recognized as a standard because of the geopolitical relationship with the mainland. Although LEED is used internationally, it was initially launched in 1998 by the U.S. Green Building Council as a tool to measure building performance in a modern American urban environment with temperate climate, a steady economy and easy access to technology. Furthermore, regionalization strategies such as Regional Priority Credits (RPCs) and Alternate Compliance Paths (ACPs), do not address the sociocultural reality of many regions. Therefore, the focus of this research is to analyse current indicators and explore which ones should be added, modified, or substituted to develop a revised LEED model for the specific sociocultural context of P.R.

The contribution of this research is to propose a framework to assess applicable sustainability criteria for the local context and strengthen LEED's cultural sustainability component. The mixed methods research design includes a comparison of international and tropical Sustainable Assessment Systems (SAS) such as LEED, BREEAM, the Living Building Challenge, SB Tool, BCA Green Mark (Singapore), RESET (Costa Rica) and TERI-GRIHA (India), among others, to explore current trends and needs. Furthermore, an action research agenda guided the development of research instruments (survey and interview questions) to promote a strong collaboration with local design and construction professionals of LEED certified case study schools to ensure that the proposed modifications are relevant for the local context. The analysis of Architectural and Placemaking strategies employed by participants in their projects informed the development of six (6) new LEED context-specific cultural Pilot Credits and the revision of five (5) existing ones. These indicators are included in the *LEED Cultural Sustainability Credit Guide* (Appendix X), developed to facilitate the dissemination process of this research findings amongst LEED users. The research methodology and proposed indicators can be adapted for other contexts and SAS.

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List of Abbreviations

ACIP	Urban Institute's Arts and Culture Indicators Project
ACPs	Alternative Compliance Paths
ADaRSH	Association for Development and Research of Sustainable Habitats
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BCA Green Mark	Building & Construction Authority- Green Mark
BREEAM	Building Research Establishment Environmental Assessment Method
DEPR	Department of Education of Puerto Rico
DGNB	<i>Deutsche Gesellschaft für Nachhaltiges Bauen</i> (German certificate for <i>sustainable</i> buildings)
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FNI	Fielding Nair International
GBCI	Green Building Certification, Inc.
GHG	Green House Gases
GIS	Geographic Information Systems
GRIHA Prakriti	Green Rating for Integrated Habitat Assessment- Existing Day Schools
GSA	General Services Administration
IC	Impact Category
IP	Interview Participant
LBC	Living Building Challenge
LEED	Leadership in Energy and Environmental Design
LEED AP	LEED Accredited Professional
LEED BD+C	LEED Building Design and Construction
LEED ND	LEED for Neighbourhood Development
LEED O+M	LEED Operations and Maintenance
LIR	LEED International Roundtable
LT	Location & Transport Category
NEB	New European Bauhaus
PBA	Public Buildings Authority
PC	Pilot Credits
PCC	Pilot Credit Committee
PCES	Programa de Certificación de Edificaciones Sustentables (Green Building Certification Program- Mexico)
POE	Post Occupancy Evaluation
P.R.	Puerto Rico
Q	Question
QP	Questionnaire Participant
RESET	<i>Requisitos para Edificaciones Sostenibles en el Trópico</i> (Requirements for Sustainable Buildings in the Tropics)
RO	Research Objective
RPCs	Regional Priority Credits
SAS	Sustainable Assessment Systems

SB Tool	Sustainable Building Tool
SBAT	Sustainable Building Assessment Tool
SDGs	Sustainable Development Goals
SoB	Sense of Belonging
SoP	Sense of Place
SPeAR	Sustainable Project Appraisal Routine
SPSS	Statistical Package for Social Sciences, also known as IBM SPSS Statistics software
TERI-GRIHA	The Energy and Resources Institute- Green Rating for Integrated Habitat Assessment
NOAA	National Oceanic and Atmospheric Administration
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USGBC	United States Green Building Council
WGBC	World Green Building Council

Publications

Sections of this chapter were previously published in Díaz-Lamboy, E., Mendoza, M., and Souto, A., 2017. [Re] measuring [LEED] sustainability: from a global rating system to tropical specificity. In: Brotas, L., Roaf, S. and Nicol, F., eds., 2017. *Proceedings of 33rd PLEA International Conference, Design to Thrive, Edinburgh, 2-5 July 2017* [online], 1, 401-408. Available at: <https://irep.ntu.ac.uk/id/eprint/31866/> [Accessed 2 February 2023].

Chapter 1: Introduction

1.1. Research Background and Problem Statement

1.1.1. Sustainability Dimensions and Green Building Certification Systems

Several definitions of sustainability and green building since the 1970s, emphasize on energy, water and materials efficiency; the reduction of environmental impact during construction and operations; as well as the health and wellbeing of building occupants (USGBC Media, 2016; Office of the Federal Environmental Executive, n.d.:8; EPA, 2016). However, the United Nations Brundtland Report (1987) stressed the need to include **social** and **economic** aspects in addition to the **environmental** considerations required to achieve sustainable development. This idea was further reinforced in models such as the “triple bottom line” (Elkington, 1999) or the “three-legged stool” (Young, 1997: 136) which encompass **environmental, social and economic dimensions or pillars of sustainability**, that are considered equally important and interdependent (Berardi 2013:73; Ebert 2011:21). While environmental sustainability is concerned with the protection of nature, its social counterpart deals with the protection of basic human rights including, but not limited to, education; equity; health; safety and security, among others (Axelsson et al., 2013: 218; Díaz-Lamboy et al., 2017: 401¹; The Energy and Resources Institute et al., 2014; United Nations, 2014; Walker, 2014). The economic dimension encourages the efficient use of resources, continued growth and long-term profit while providing support to local economies (Owens 2013:15-16).

Furthermore, the “sustainability square” model, includes **culture** as the fourth pillar, along with the social, economic and ecological dimensions (Ebert 2011:21, Mateus and Bragança 2011:1962, Culture 21, 2011:2; Agenda 21, 2008:5). While the term

¹ Sections of this chapter were previously published in Díaz-Lamboy, E., Mendoza, M., and Souto, A., 2017. [Re] measuring [LEED] sustainability: from a global rating system to tropical specificity. In: Brotas, L., Roaf, S. and Nicol, F., eds., 2017. *Proceedings of 33rd PLEA International Conference, Design to Thrive, Edinburgh, 2-5 July 2017* [online], 1, 401-408. Available at: <https://irep.ntu.ac.uk/id/eprint/31866/> [Accessed 2 February 2023].

culture encompasses the characteristics of a society, its norms, values, skills, knowledge and beliefs, recent initiatives aim to further strengthen the cultural sector and promote its integration in international education, economy and communication policies, among others (UCLG, 2018; United Cities and Local Governments, 2010: 4). For instance, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has launched a series of indicators to measure and quantify culture's contribution to the international and local implementation of its Sustainable Development Goals (SDG's) and Targets for year 2030 (UNESCO, 2019; United Nations, 2014). Within these goals, culture has acquired prominent role as "the ultimate renewable resource" that may be employed to mitigate and adapt to climate change, considering it is directly related to people's living style and habits (UNESCO, n.d.). The UN also recognizes the potential of culture as instrument in motivating global climate action, as well as the preservation and safeguarding of cultural heritage and natural ecosystems (Federal Ministry of Information and Culture, 2017).

Further initiatives that aim to contribute to the attainment of specific SDG's have emerged such as the New Urban Agenda in Quito, Ecuador that provides an urbanization tool for the sustainable development of cities and communities. The document includes culture as an important component within urban plans and strategies, to safeguard cultural heritage and landscapes from potential disruptive impacts of urban development (United Nations, 2016: 32). Furthermore, the New European Bauhaus (NEB) Compass (2022) consists of a framework for "decision and project makers", that may want to apply sustainability, aesthetics, and inclusion "values" in their built projects. Particularly, the aesthetics component aims to integrate socio-cultural values in the built environment through artistic creation, and foster Sense of Belonging (SoB) by providing meaningful experiences that target user's senses, emotions and needs (New European Bauhaus, n.d.). The cultural dimension of sustainability will be further explored throughout this investigation, in order to demonstrate its application in current certification systems.

Worldwide, certification or 'sustainable assessment' systems (SAS) such as the Leadership in Energy and Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEAM), among others have provided a framework of reference by including criteria and objectives of what a sustainable building should be. However, these systems focus primarily on targeting the environmental pillar through environmental protection and resource efficiency, sometimes overlooking other dimensions of sustainability such as the social, cultural and economic indicators which are an essential part of its definition, presenting a research gap (Berardi 2013:74; Mateus and Bragança, 2011:1962). This gap was further explored in the International Comparison of SAS (Chapter 6) developed for this research, which revealed the specific sustainability pillars that are mainly targeted by SAS, and those that should be strengthened, both at internationally and in LEED.

International certification systems such as LEED have been used worldwide to rate buildings beyond their country of origin, including Puerto Rico (P.R.). This Island, located in the Caribbean, holds the largest amount of certified projects in the region (USGBC, 2016a) and will be used as case study. Being a United States Commonwealth, the LEED SAS has become the most widely recognized standard because of the geopolitical relationship with the mainland. While P.R. shares a common Hispanic background with nearby countries, green building is subject to U.S. laws, building codes and regulations even though its culture, climate, construction systems and native language are different.

The present study analyses and questions the validity of U.S. LEED as a reliable tool to evaluate buildings in the tropical Caribbean region, particularly in Puerto Rico. It also identifies what credits should be added, modified or substituted to develop a revised LEED model for its specific cultural context. This research will revise current and propose new sustainability indicators for the particular case of Schools. Also, this Ph.D. Thesis will assess USGBC's regionalization strategies and Innovation in Design credits to attempt to adapt the system to the local context.

1.1.2. School Sustainable Assessment Systems (SAS)

Sustainable Assessment Systems such as LEED and BREEAM, among others, are mostly based on weighting building performance and environmental impact mitigation through building resource consumption, mechanical systems efficiency and overall site planning. However, these criteria might overlook critical social components when assessing educational institutions. Schools are hubs for social and emotional learning and may promote social mobility by providing pathways for graduates to change positions within the social stratification system (Friedman, 2022). Furthermore, schools play a cultural role beyond its building components, being entrusted with the responsibility of teaching future generations about a country's history, traditions, and values in addition to the general curriculum artistic, scientific and technical subjects. Schools may also be considered "community hubs", a task further emphasized by the World Health Organization and UNESCO partnership to promote health and education through eight (8) global standards, one of which advocates for school and community collaboration to achieve the desired outcomes (World Health Organization, 2021). Similarly, Colless and et al. (2022) identifies schools as an "underutilized asset", and provides recommendations to promote "better design and sharing of school infrastructure that improves education and strengthens communities".

Considering schools may influence student's views toward society and the environment it is the focus of this investigation to assess the applicability of LEED in local certified projects. The project will focus on public schools, which are the learning centre for more than 75% of the K-12² student population in Puerto Rico (Instituto de Estadísticas de P.R., 2014:13). Nine (9) out of ten (10) green public schools in the Island were certified under the *Schools for the 21st Century* federally funded³ initiative (2010-12) or the extended program titled *Schools First* (2013-16),

² Based on the U.S. and P.R. Educational system, which names school levels prior to college as kindergarten (K) through the 12th grade (12).

³ The American Recovery and Reinvestment Act (ARRA) signed in 2009 by U.S. President Barack Obama, was developed to stimulate the economy of the U.S. and its Territories, including P.R. Nationwide, \$787 billion dollars were destined for improvements in

which included the construction, “modernization, renovation, or repair of public school facilities”, which had to be certified, verified or consistent with LEED or equivalent (U.S. Department of Education, 2009; U.S. Senate, 2008:22099). This project was extended to all 78 municipalities and promoted Puerto Rico’s largest public school improvement program in decades (Fielding Nair International, n.d.: 3).

Since the majority of school buildings are based on a prototype developed during the 1940s, their aging infrastructure and lack of maintenance required major remodelling or reconstruction. The reorganization also brought changes such as consolidation of schools, closing, demolishing, and the repurpose of structures⁴ due to a decrease in the number of students since the 1980’s (Roman, n.d.:6). There has been an enrolment reduction of 61% from 2012-2021 because of a decline in birth rate, an increase in emigration, among other factors, which might require further infrastructure improvements (DEPR, 2021; Roman, n.d.:6-7). The findings of this PhD Thesis can serve as a guide for the future adaptation of school structures, those with significant architectural value or the construction of new ones.

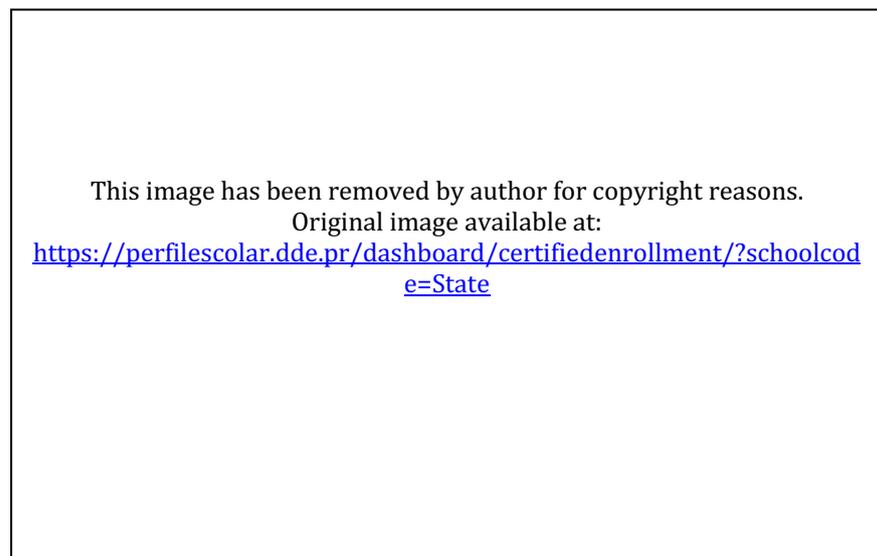


Figure 1-1: Student Enrolment per Academic Year (2012-2021) (DEPR, 2021)

education, energy, technology and infrastructure, among other areas. The P.R. Education Department was allocated a total of \$1,288.8 million to strengthen academics in grades K-12, in addition to improving public schools physical and technological infrastructure (Anon., 2012).

⁴ Puerto Rico had a total of 1,464 public schools in 2014 and 849 in 2021, a reduction of 57.9% (NCES, 2021, 2014).

1.2. Research Aim, Hypothesis, Objectives and Contribution to Knowledge

The **main aim** of this research is to identify and integrate P.R.'s cultural factors into LEED's Pilot and Regional Priority Credits for the particular case of Schools, in order to adequately adapt this system for P.R.

The research **hypothesis** states that sustainability is a universal concept but its effective application depends on its regional adaptation to the local environmental, economic, social and cultural context. The instrument or green rating system must be calibrated, valid and reliable to reflect these conditions and to serve as an industry benchmark in P.R.

This investigation will target the following **research objectives (RO)**:

- RO1: Determine if the U.S. LEED certification program addresses social and cultural elements as sustainability indicators.
- RO2: Analyse how LEED indicators and regionalization initiatives by the USGBC could be modified to respond effectively to the tropical context of P.R.
- RO3: Identify what aspects of sustainability⁵ in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators.
- RO4: Develop a methodology or framework to assess and evaluate applicable sustainability criteria that could be incorporated into the LEED SAS.
- RO5: Propose modifications to existing LEED credits and new cultural sustainability indicators adapted for the local context.

Even though the original aim of the thesis was to investigate both social and cultural elements, it became clearer that within the boundaries of the PhD thesis it was only

⁵ Sustainability includes environmental, economic, social and cultural dimensions.

feasible to focus on the cultural one. Furthermore, the analysis of SAS worldwide included in Chapter 6, revealed that certification systems have a limited number of cultural indicators, if any, when compared to the social dimension, which has experienced an increase in recent years. For example, LEED created a Social Equity Working Group to develop more indicators in that area, as indicated in Chapter 2. Even though this research focuses on culture, it acknowledges that all sustainability dimensions are intertwined by including environmental, social and economic considerations applicable to this pillar. Future research could explore the remaining pillars following the proposed methodology.

This research will revise existing and propose new cultural credits for the LEED Building Design and Construction (BD+C) and Operations and Maintenance (O+M) systems for existing schools in P.R. Both systems encompass a wide range of criteria from sustainable sites up to interior considerations, which will allow these research findings to be applicable to other sub-systems elsewhere. While BD+C targets new schools, O+M could be used to re-certify the existing ten (10) LEED-New Construction⁶ schools plus serve as a guide for improving and/or certifying the 81 public schools in Puerto Rico remodelled under the Schools for the 21st century program.

The **contribution to knowledge** of this research is to propose a framework to assess applicable cultural sustainability criteria for the local context. While in this case, Puerto Rico served as case study, the methodology could be adapted to other countries, regions and SAS. The methodology includes an International Comparison of SAS (Chapter 6) or benchmarking of indicators as a way to study global trends and determine the sustainability dimensions targeted by each indicator. A Coding Manual was developed to ensure consistency in the coding process, facilitate replications and/or updates of this study when new SAS versions or indicators are launched. Also, this benchmark has generated a list of indicators or themes for participants to

⁶ To apply for LEED Operations and Maintenance (O+M), buildings must be in operation for at least 1 year. Projects must apply for re-certification at least every 5 years, once they are certified initially under O+M (USGBC 2017).

prioritize for the local context. This methodology allows SAS to be kept up to date, according to new trends and emerging needs.

The intention of this research framework is to develop new LEED indicators that could be incorporated into the LEED system to make it more responsive to the P.R. context. This study includes documented Action Research strategies and strong consultation processes to bridge the gap between LEED and professionals. The inclusion of LEED users in the assessment of this SAS and Pilot Credit (PC) development processes ensures that the proposed modifications are relevant and valid for the local context, target user needs and contribute to the development of SDG's. The professionals involved are the ones that may submit the credits resulting from this research to LEED and may benefit from this thesis findings. These professionals may also be motivated to test these PC credits in their projects because they were part of their development process. The thesis has produced a tangible by-product, the development of the *LEED Cultural Sustainability Credit Guide* (Appendix X) to facilitate the dissemination process amongst LEED users and the USGBC. This research could also serve as a model for professionals that may want to employ this methodology to propose new indicators adapted for their regional context.

Furthermore, the research instruments (survey and interview questions to design and construction professionals) were designed to analyse LEED's applicability in the local context, but also as a cultural assessment tool to evaluate what cultural aspects, architectural and placemaking strategies suitable for the local context were implemented in the projects. The strategies employed by professionals informed the development of new and revised context specific indicators.

1.3. Thesis Structure and Synopsis

This thesis consists of nine (9) chapters, including this introduction. Figure 1-2 presents an extract of the Methodological Framework in Chapter 5 and includes an alignment between the research objectives, techniques, and the thesis chapters, as will be further explained in this section.

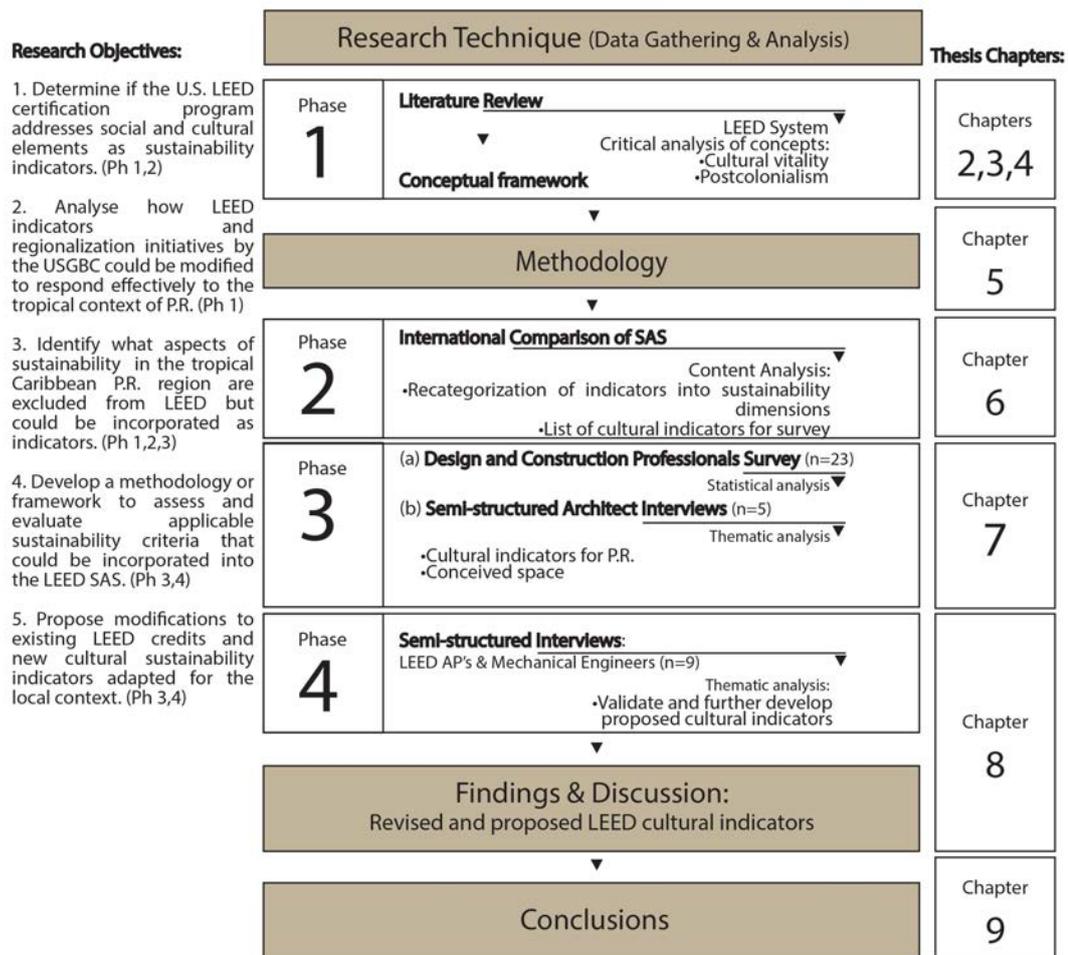


Figure 1-2: Extract from Methodological framework. Presents the alignment of thesis chapters with the research phases and objectives (by author).

In order to determine if the U.S. LEED certification program addresses social and cultural elements as sustainability indicators (**RO1**), an in-depth literature review and analysis of LEED was carried out in Phase 1 and is summarized in **Chapter 2, Green Building, Certification Systems and Regional Adaptation**. This chapter includes an overview of the Leadership in Energy and Environmental Design (LEED) system, its priorities and sustainability dimensions considered. Arguments presented throughout the chapter, demonstrate that LEED’s focus is on targeting the environmental dimension of sustainability, while there is also a need for the system to strengthen the cultural component. The analysis of LEED indicators and regionalization initiatives by the U.S. Green Building Council (USGBC) (**RO2**) informed the implementation strategy for the research findings, which includes the

development of Pilot Credits to better adapt the system to the local context and improve its effectiveness in measuring sustainability in P.R.

In order to identify what aspects of sustainability⁷ in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators (**RO3**), the literature review in Chapters 3 and 4, defines and analyses concepts such as cultural vitality and Postcolonialism to better understand the application of LEED in the Island. **Chapter 3, *Assessing Culture in LEED Through a Postcolonial Lens***, explores the role of culture in sustainable development (Mateus and Bragança, 2011; Soini and Dessein, 2016: 4). Also, analyses the LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013: 2), particularly the *Enhance Social equity, environmental justice, community, and quality of life* IC which includes a brief reference to how buildings impact culture. LEED's culture-related IC components and measures, namely Sense of Place (SoP), cultural identity, and expression are key to achieve cultural vitality in the built environment and were further defined. This chapter references Postcolonialism and Henri Lefebvre's third space theories, in order to understand how a designer's cultural beliefs/intentions were expressed in local educational building designs. Includes the conceptual framework that summarizes the main concepts analysed.

Chapter 4, [Re] defining P.R. Cultural Identity, presents a historical background for this research in which the local hybrid culture has been affected by social, environmental, and economic events that have formed or re-defined it, and vice versa. This research identifies the people (Puerto Ricans) and a particular architecture style (Tropical Architecture) as the epitome of hybridity in the Island, and as necessary background to contextualize school sustainable architecture. The understanding of the user and place will allow for the development of LEED indicators specific for the P.R. context. Architectural designs under Spanish dominion and American tutelage will be discussed in order to contextualize the Schools for the 21st Century project analysed on this research.

⁷ Sustainability includes environmental, economic, social and cultural dimensions.

Chapter 5, Research Methodology, presents the research paradigm, design and techniques employed aim to answer the following question: What credits should be added, modified, or substituted to develop a revised LEED model for its specific socio-cultural context? The research methodology aligned with the conceptual framework, focused on *conceived spaces* as defined by design and construction professionals of local LEED certified schools. Data collection methods and research instruments explored schools as cultural spaces and prioritized participant's point-of-view and interpretation, based on the Subjective Ontology and Interpretive Epistemology paradigms. Also, promoted collaboration between the researcher and professionals through Action Research strategies to propose an agenda for reform to develop indicators to improve cultural vitality in LEED.

To explore sustainable architecture and the LEED infrastructure in the Island, all ten (10) certified public schools were examined. The Mixed Methods Research design aligned with the five (5) research objectives (RO), included a survey and semi-structured interviews. The online survey was administered to the Architects, Engineers and Sustainability Consultants (LEED AP's) of the selected eight (8) schools on the mainland to inquire about culture and the LEED certification process (Phase 3a).

Five (5) case study schools were then selected for in-depth analysis based on the Department of Education of P.R. Educational Regions distribution. Qualitative semi-structured interviews were performed to the five (5) licensed Architects who designed the green schools located in regions I and II (Phase 3b). The survey and interviews included a cultural assessment of schools in P.R. to investigate cultural identity and expression in the design of case study schools.

An additional round of semi-structured interviews to seven (7) LEED AP's and two (2) mechanical engineers was carried out (Phase 4) to further develop the thirteen (13) socio-cultural indicators that were preliminarily identified as important to the P.R. context in the online survey. In this second round of interviews, there was representation from all ten (10) LEED certified public schools in P.R. Findings from

these phases will be further discussed on chapters 7-9. The methodology or framework, as well as the research instruments, were designed to assess and evaluate applicable sustainability criteria that could be incorporated into the LEED SAS (**R04**).

The international comparison of school SAS in **Chapter 6**, expands on the literature review in Phase 2 and references widely used **international** SAS such as **BREEAM**, **Sustainable Building (SB) Tool** and the **Living Building Challenge**, its categories, indicators and weightings. Also, **localized** systems such as **Requirements for Sustainable Buildings in the Tropics (RESET)** in Costa Rica, **Green Mark** in Singapore and the **Green Rating for Integrated Habitat Assessment (GRIHA)** in India, among others, that have emerged as a specific solution to the problems of a particular country or region within the tropics, will be discussed. A comparison between LEED and these certification systems will inform proposed revisions to existing LEED credits and new cultural sustainability indicators adapted for the local context (**R05**).

Chapter 7, Cultural Indicators and the Conceived Space, expands on the methods employed in phase 3, survey and first round of semi-structured interviews. Includes case study selection criteria, sampling strategy, recruitment procedure and research instruments, as well as the participant's profile. Furthermore, discusses the Conceived Space, particularly focusing on user perception, design intention and building use. The chapter presents the analysis employed to select the preliminary list of cultural indicators, as well as specific architectural and placemaking strategies employed in local case study schools that informed the development of proposed LEED indicators.

Chapter 8, Cultural Indicators, expands on the research methodology employed on phase 4 (second round of semi-structured interviews to sustainability consultants and mechanical engineers), explaining the recruitment strategy, outlining the participant profile and describing the research instrument. Also, explains how the thematic analysis was carried out, followed by recommendations for LEED existing

indicators and proposed Pilot Credits, organized under Cultural Vitality categories. The booklet on Appendix X titled *LEED Cultural Sustainability Credit Guide* serves as companion or guide for this chapter and presents the proposed credits utilizing LEED's format and language. Also, will be a very useful tool for disseminating this research findings amongst LEED users and the USGBC.

Chapter 9, Conclusions and Recommendations, focuses on answering the research question: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context? While the end result was the development of a total of eleven (11) indicators (5 revised, 6 new), the research process and methodology employed is a valuable contribution in itself, considering credits were developed through strong consultation processes with professionals. The methodology could be replicated and adapted to other contexts and could serve as tool for professionals that may want to develop their own Pilot Credits. The chapter structure presents each of the five (5) research objectives, explains the strategies employed on each phase to develop these indicators and meet the established aims.

Additionally, the chapter presents the research limitations regarding the selected target population and implementation strategy. Also, proposes a dissemination strategy for this research findings amongst professionals and the USGBC aided by the *LEED Cultural Sustainability Credit Guide* (Appendix X) and expands on the contribution to knowledge presented on this chapter (section 1.2). The text details opportunities for further research including, but not limited to, the development of indicators that target other sustainability dimensions (social, economic), promote community participation and co-design, and reward passive design strategies in LEED. Also, outlines additional recommendations for the improvement of the research instruments developed for this study so that these can be administered to a different population or context.

Chapter 2: Green Building, Certification Systems and Regional Adaptation

2.1. Introduction

This chapter includes an overview of the LEED system, its priorities and sustainability dimensions targeted. The analysis presented in section 2.2 will contribute to determine if the LEED SAS addresses social and cultural elements as sustainability indicators (RO1).

Furthermore, this section will reference widely used international SAS such as BREEAM, Sustainable Building (SB) Tool and the Living Building Challenge, as well as systems such as Requirements for Sustainable Buildings in the Tropics (RESET) in Costa Rica, Green Mark in Singapore and the Green Rating for Integrated Habitat Assessment (GRIHA) in India, among others, developed in tropical countries. A comparison between LEED and these certification systems will inform what sustainability dimensions are targeted worldwide and which should be strengthened.

Furthermore, an in-depth analysis of LEED current regionalization strategies, including Regional Priority Credits, Alternate Compliance Paths, Pilot Credits and Climatic Location will contribute to determine the best strategy to adapt the system for the tropical context of Puerto Rico (RO2). Finally, the implementation strategy for recommendations resulting from this investigation will be discussed in section 2.3.

2.2. Leadership in Energy and Environmental Design (LEED) Overview and its Implementation in Puerto Rico

The Leadership in Energy and Environmental Design (LEED) system provides a framework or guide for professionals that want to document their building's sustainable strategies and earn a globally recognized certification for their projects. This SAS was developed by the United States Green Building Council (USGBC), an organization founded in 1993 by Rick Fedrizzi, David Gottfried and Mike Italiano (Díaz-Lambooy et al., 2017⁸; USGBC, 2016). Following an initial pilot version of LEED in 1998, the system has gone through several revisions, including LEED V.3 (2009), V.4 (2013), and V.4.1 (2018). Even though this investigation is based on LEED V.4, which was the current version at the time of analysis, we will reference relevant updates in V.4.1 throughout the text. It is important to point out that the most recent version 4.1 (2018), does not include the cultural indicators and initiatives proposed in this investigation, which makes this thesis proposal still relevant and necessary, even if it was originally based on version 4 (2013).

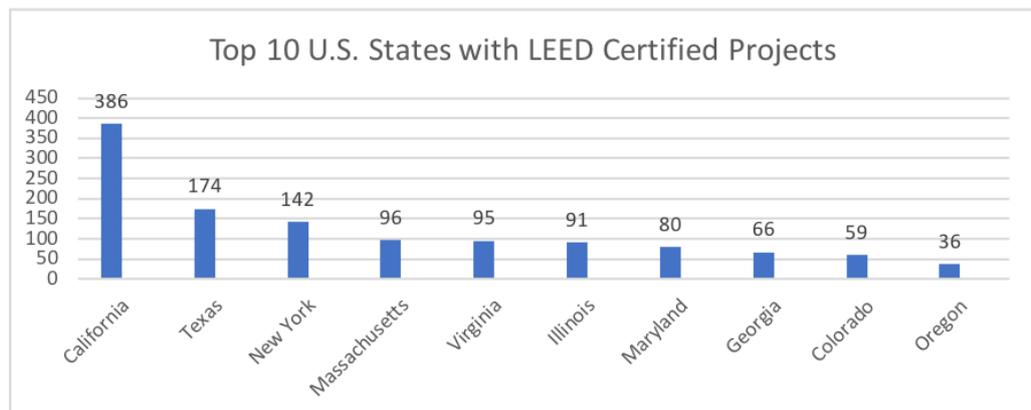
LEED comprises a family of rating systems that address several building types in different stages of development (Todd et al., 2013, USGBC, 2016c), these are:

- Building Design and Construction: includes New Construction and Major Renovation, Core & Shell, Schools, Retail, Hospitality, Data Centres, Warehouses & Distribution Centres, and Healthcare.
- Interior Design and Construction: includes Commercial Interiors, Retail and Hospitality.
- Building Operations and Maintenance: includes Existing Buildings and Interiors.
- Neighbourhood Development (V.4); Cities and Communities (V.4.1)
- Residential: Single and multifamily homes

⁸ Sections of this chapter were previously published in Díaz-Lambooy, E., Mendoza, M., and Souto, A., 2017. [Re] Measuring [LEED] sustainability: from a global rating system to tropical specificity. In: Brotas, L., Roaf, S., and Nicol, F., eds., Network for Comfort and Energy Use in Building, Edinburgh, 401–408.

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Original image available at: <https://www.gbci.org/us-green-building-council-releases-2019-top-10-countries-and-regions-lead>

Countries and regions with LEED certified projects (Source: Merricks, 2021, modified by author to include ranking based on number of projects and add specific information on the U.S. and P.R.). The U.S. and Canada represents the largest market with 38,045 certified projects. The 55 certified projects in P.R. are included within this number. The Latin America and Caribbean region occupies the 4th position with 1,854 projects certified.



Top 10 U.S. states with LEED certified projects. Note: Even though P.R. and Washington D.C. possess a significant number of certified projects, do not appear in the top 10 list because these are not states. Chart by author based on information on the USGBC webpage (Verdinez, 2023).

Figure 2-1: Rankings based on number of LEED certified projects

Although LEED was designed in the United States and primarily reflects U.S. market conditions, it has been used extensively around the world (Díaz-Lamboy et al., 2017:401). While there are more than 178 countries or territories using LEED, the U.S. represents its largest market with 34,639 certified projects and 425.80 Gross Square Meters (GSM) (Gagiuc, 2020, Merricks, 2021). P.R. projects are included within this number and account for less than 1% of total. However, when compared with the top 10 U.S. states with LEED certified projects in Figure 2.1, the Island's total number of projects (55) is in-between Colorado (59) and Oregon (36), a significant amount considering P.R. has a smaller land area in square miles (km²)⁹ (Figure 2-1). Neither P.R. nor Washington D.C., the U.S. capital, were included in the USGBC top 10 list, because these are not states, even though both have a noteworthy number of projects when compared to other states on the list. However, the number of projects in the U.S. capital was highlighted with a note, a strategy that could also be employed for the case of P.R.

Furthermore, a comparison between P.R. and countries in the Latin American and Caribbean region was also performed due to its common background and location with these neighboring countries. As shown in Figure 2-2 and Figure 2-3, Puerto Rico is on the 10th position, out of 48 countries in Latin America and the Caribbean for LEED, while in the Caribbean region is ranked second with a total of 55 certified projects. Additionally, 96 projects are labelled as “registered”, in track for completing the certification process (USGBC, 2022a).

When this analysis was first performed in earlier stages of this research project (2018), Puerto Rico held the first place within the Caribbean countries, later being surpassed by the Cayman Islands with 74 certified projects (USGBC, 2022a). However, Puerto Rico currently has more registered projects (96), than the latter that has 44. Even though the reasons behind the slow pace in the number of yearly certified projects may be a topic for further research, this study proposes the adaptation of LEED indicators for the local context which, in turn, may promote the

⁹ Colorado has 103,730 square miles, Oregon has 96,003 and P.R. has 3,435 (*Size of States, 2014*; Government Development Bank for Puerto Rico, 2016).

certification of new projects, particularly schools.

Currently there are over 2,600 K-12 LEED certified schools worldwide (Heming, 2021). In P.R. there are currently nine (9) certified schools, which comprises a 6.1% of the total certified projects in the Island. Additionally, three (3) schools are “registered” (32% of total registered projects in P.R.) (USGBC, 2022a). However, due to a lack of specificity on the USGBC Project Directory to reveal whether a “registered” project’s certification is still in process or was cancelled, there is no accurate information available on how many projects might still earn their certified status in the near future. Once a project is registered it will remain in the Directory and there is not an established time limit for it to be removed even though it will not follow through with the certification process.

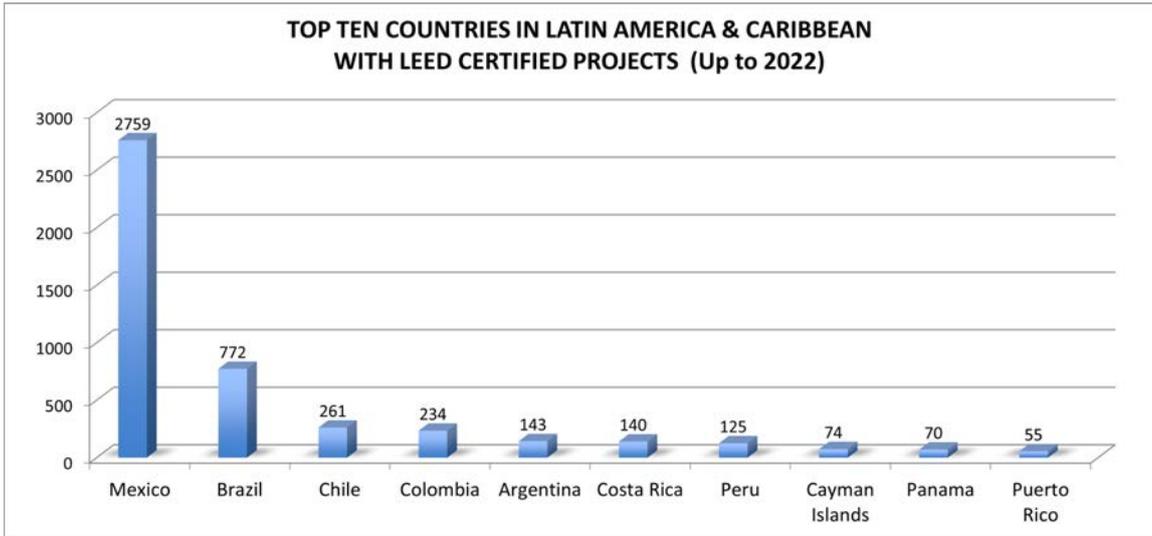


Figure 2-2: Latin America & Caribbean Region Summary. Top ten countries in Latin America & Caribbean with LEED projects. Graph shows total number of certified projects per country. Total number of countries in the Latin America & Caribbean region= 48. Data sources: USGBC Project Directory (2022). Graph by author, November 2022.

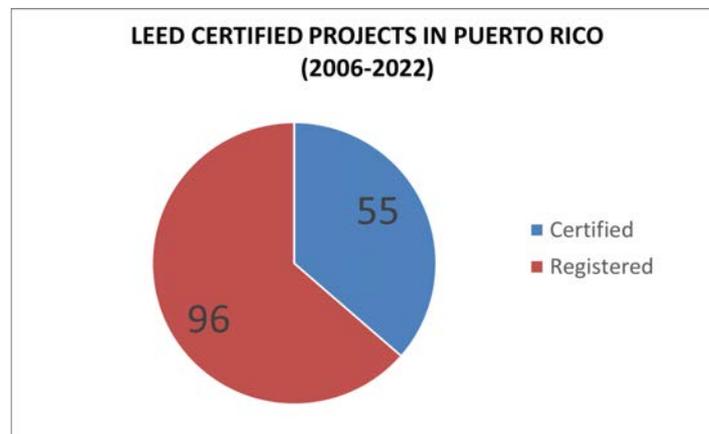
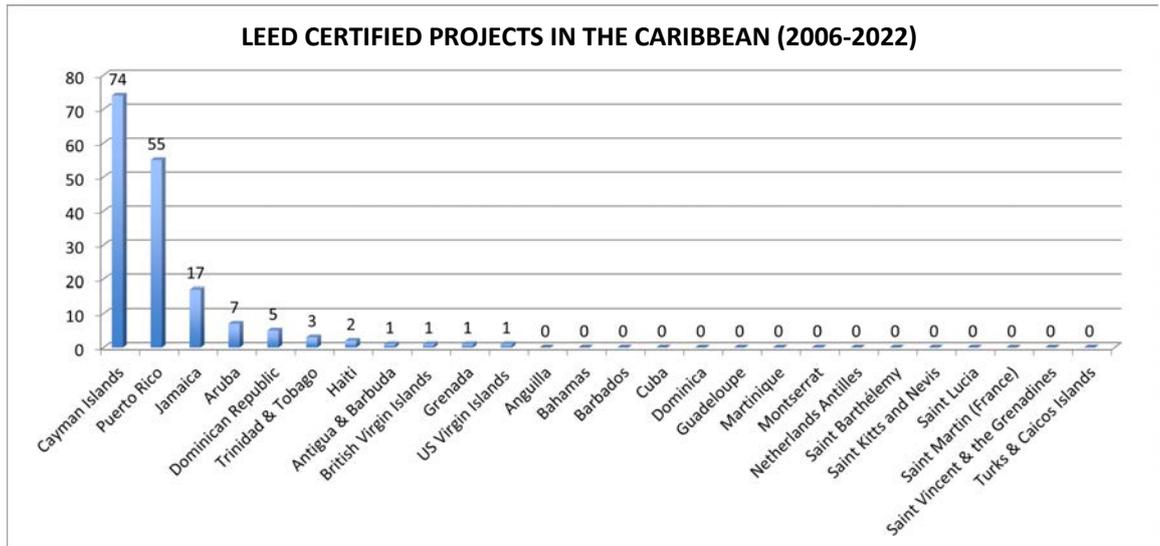


Figure 2-3: LEED certified projects in the Caribbean and Puerto Rico. Source: USGBC 2022; charts and analysis by author.

While most Green Building Councils in the Latin America and Caribbean countries promote LEED as their main SAS, several countries including Brazil (Selo Azul de Caixa), Mexico (PCES), Costa Rica (RESET) and U.S. Virgin Islands (Green Building Certification) have developed their own SAS that incorporate bioclimatic and/or social indicators in an attempt to address local needs (Díaz-Lamboy et al., 2017: 404). These systems will be further analysed on Chapter 6.

The increasing widespread use of the most renowned certification systems-BREEAM and LEED- could be attributed to a perceived need for a common international vocabulary and brand that can facilitate communication with stakeholders and comparison between sustainable buildings (Cole and Valdebenito, 2013:673-674). Cole and Valdebenito also reference government agencies or multinational

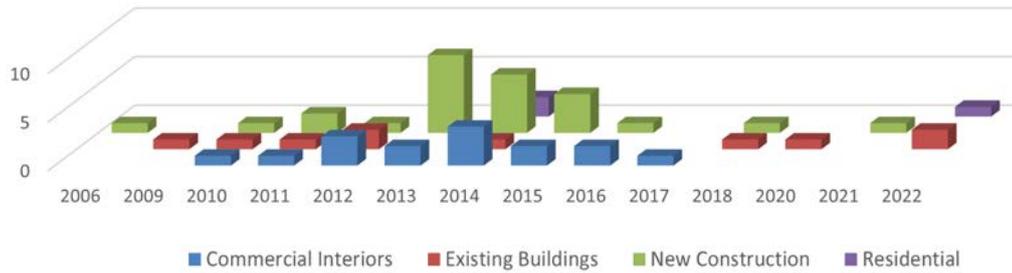
companies with projects worldwide that seek consistency in their environmental assessment methods as another factor for promoting worldwide adoption of a particular SAS.

This is also evident in P.R., where most LEED certified projects were developed with federal U.S. funding or with capital from American multinational companies. As shown in Figure 2-4, most projects were certified during years 2013 to 2015, which coincided with the availability of the ARRA federal stimulus funding and the Schools for the 21st Century project. Furthermore, the implementation of federal Executive Orders, local government laws and the U.S. General Services Administration (GSA) recommendation resulted in 51% of LEED certified projects in P.R. being new construction or major renovations of government buildings during years 2006 to 2022.¹⁰ The remaining 38% of certified buildings were funded by private capital, mostly from American pharmaceuticals, hotels, retail or health companies and 7% by Non-profit organizations (Federal Facilities Env. Stewardship & Compliance Assistance Center, 2007; Kaplow, 2013; Office of the Press Secretary, 2015).

¹⁰ The Green Building Initiative's Green Globes SAS was also recommended by the GSA for use in federal buildings (Kaplow 2013). In 2010, the GSA upgraded the required certification level to LEED Gold, as a minimum for all new construction and major renovations federal projects (GSA, 2010) .

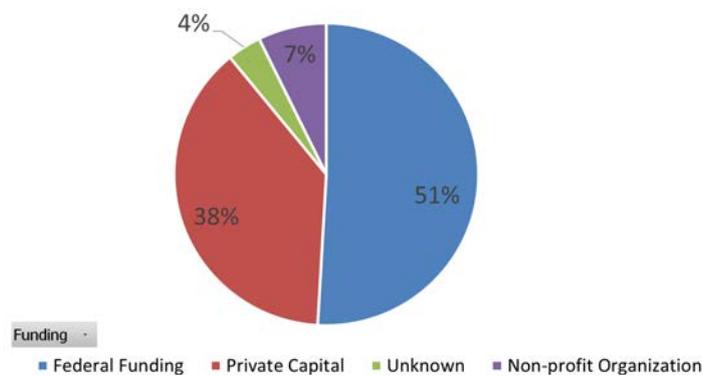
Another early initiative in P.R. was law number 161- 2009, which promoted green construction by establishing expedited permit processing and discounted fees for buildings that demonstrate compliance with local priority requirements such as energy and water conservation, indoor air quality, efficient use of materials, innovation and integrated design, among others (OGPe, 2009). Projects could either comply with local guides or be certified under one of the approved rating systems, including LEED. However, the established criteria are similar to those in LEED, and also exclude socio-cultural dimensions. Analogous to Green Globes, the green permit process requires an on-site verification visit from an authorized professional. This initiative never took off to be a counterpart of LEED.

LEED CERTIFIED PROJECTS IN P.R. PER CATEGORY (2006-22)



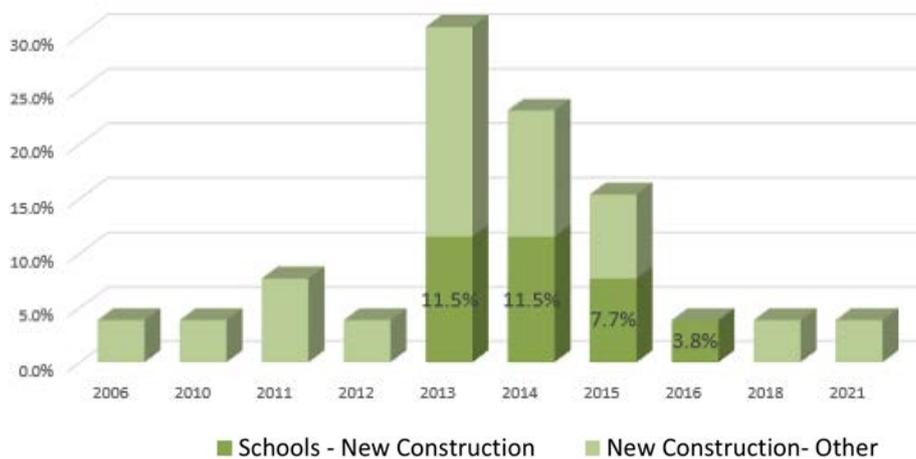
Illustrates the number of certified projects under the Commercial Interiors, Existing Buildings, New Construction and Residential building types. Most NC projects were built during years 2013-15.

FUNDING SOURCES- LEED CERTIFIED PROJECTS IN P.R. (2006-22)



Depicts that most LEED certified projects in Puerto Rico are federally funded, followed by those financed by private capital and non-profit organizations.

LEED NEW CONSTRUCTION CERTIFIED PROJECTS IN P.R. (2006-22)



Illustrates LEED New Construction certified projects in Puerto Rico, comparing New Construction Schools (n=9) vs. New Construction- Other* (n=17), which includes retail and institutional projects. The years that are not shown have zero (0) certified projects.

Figure 2-4: Overview of LEED projects in Puerto Rico. Source: USGBC 2022; charts and analysis by author

Building design and construction industry professionals, such as American architects practicing locally or abroad, as well as local professionals that studied in the U.S. and had experience and/or preference for LEED might have promoted its selection for their projects in P.R. Also, the USGBC Caribbean Chapter founded in 2005, disseminated and promoted the adoption of green building practices in P.R. and the certification of LEED Accredited Professionals (LEED APs), qualified to evaluate and certify sustainable buildings (USGBC P.R. Chapter, 2016).

According to Cole and Valdebenito (2013:663), all SAS reflect the values and main concerns of their developers and country of origin. LEED's priorities coincide with those established by the U.S. Government in the Executive Orders previously discussed, which promote energy efficiency and preventing Greenhouse gas (GHG) emissions that can contribute to climate change. This can lead us to question to what extent- without adaptation - the LEED system can be used effectively in other countries, including P.R. to support cultural and climate-appropriate design practices. In order to understand LEED's priorities, the next section will discuss the system's categories, the sustainability dimensions considered and the methodology used by the USGBC to determine criteria weightings.

2.2.1. Section Weightings, Categories and Credits

LEED's most recent version 4.1 (2018), contains prerequisites and credits in nine (9) categories: Integrative Process, Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation and Regional Priority (USGBC, 2022b). To determine the LEED score, the total obtained in each criterion is added up, the maximum being 110 points for Building Design and Construction and 100 points for Operations and Maintenance. The number of credits achieved determines the project certification level as Certified, Silver, Gold or Platinum (the highest ranking) (Díaz-Lamboy et al., 2017: 404; USGBC, 2022).

Credit and category weightings drive the system's priorities and contribute to the final award level. The categories in version 4 and 4.1 remained the same even though

several credits were revised, added, or eliminated in the revision (USGBC, 2022b). As shown in Figure 2-5, the Energy and Atmosphere (EA) category has been consistently assigned the largest number of possible points, in LEED versions 3, 4 and 4.1. This confirms that the LEED system places greater emphasis on targeting environmental problems than on the social, economic, or cultural sustainability dimensions.

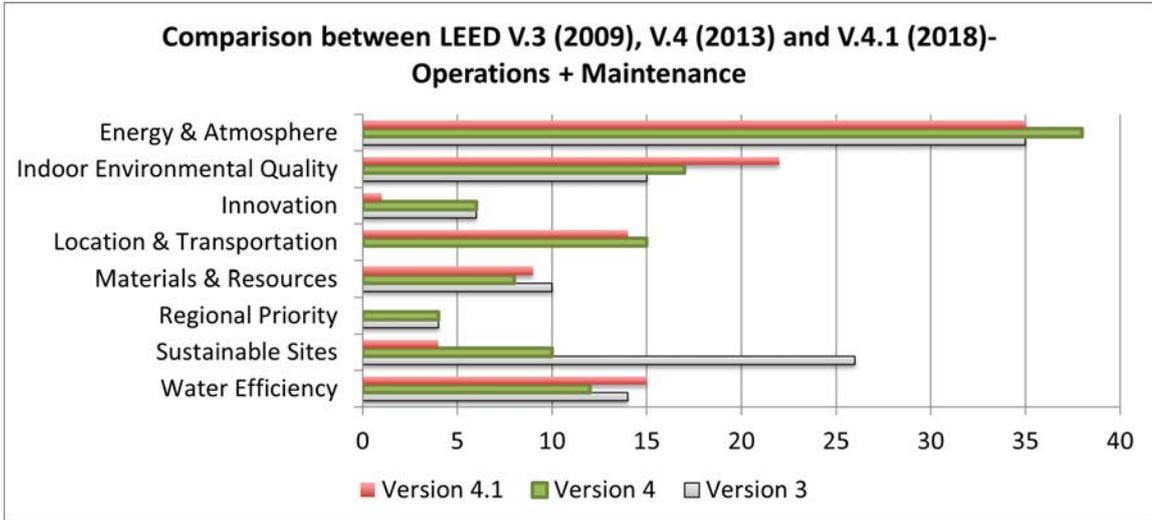
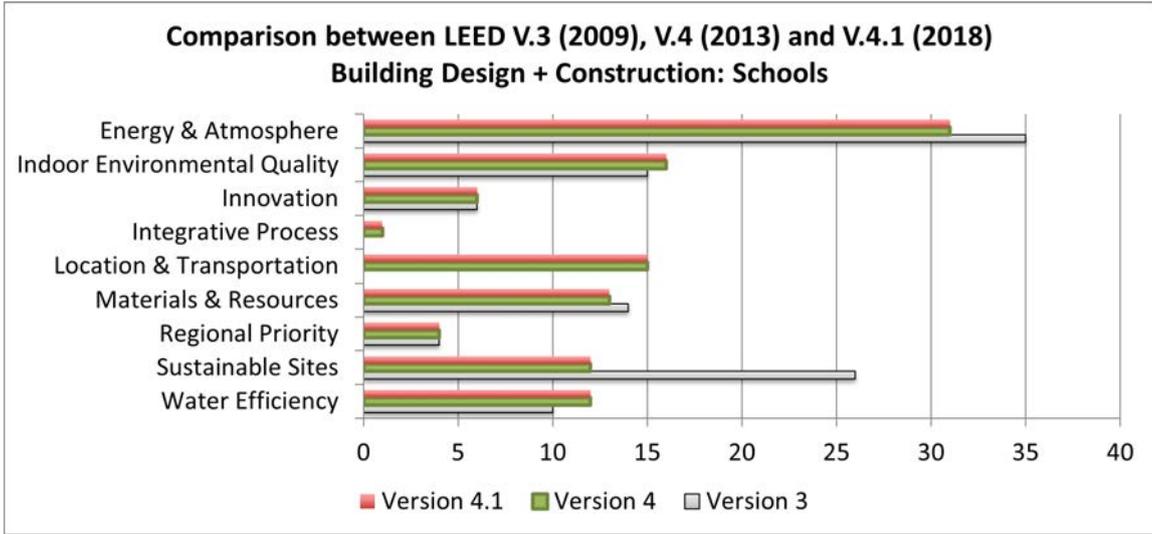


Figure 2-5: LEED Categories and weighting distribution (total possible points), versions 3, 4 and 4.1. Graph by author. Data source: (USGBC, 2022b)

It was in LEED version 3 (2009) that variations in credit weightings were included for the first time, based on the Environmental Protection Agency's *Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts* (TRACI) categories¹¹ (US EPA, 2015). However, this computer software, commonly used in Life Cycle Assessments and the evaluation of materials, is focused mainly on targeting environmental problems. The use of TRACI, developed specifically for the North American building market, raised questions regarding LEED's applicability in other countries (Owens et.al., 2013:2; Suzer, 2015:268; USGBC, 2008:1).

Therefore, the new methodology employed by the USGBC to determine LEED version 4 priorities (2013) was used as reference for this research. Its emphasis was on the built environment and LEED's "social, environmental and economic goals" while providing metrics for determining its ability to meet them. The development process was dedicated to answering this question: "What should a LEED project accomplish?" (Owens et.al., 2013: 2).

The LEED Steering Committee developed seven (7) system goals or Impact Categories (IC) to answer this question, namely:

- Climate change
- Water resources
- Human health and well-being
- Social equity, environmental justice, and community quality of life
- Material resources
- Biodiversity
- Greener economy

¹¹ TRACI Impact Categories include: ozone depletion, climate change, acidification, eutrophication, smog formation, human health impacts, and ecotoxicity (US EPA, 2015).

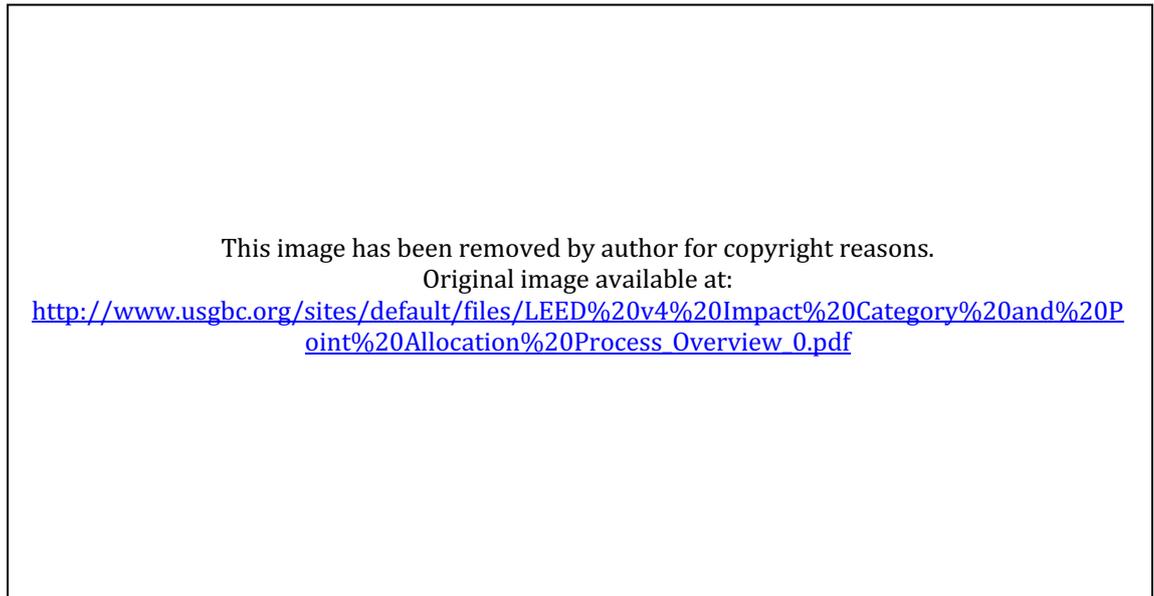


Figure 2-6: LEED version 4 Impact Categories(Owens et al., 2013: 4)

Out of a consensus driven process, each IC was assigned a weighting based on the relative impact of the built environment on each category (Figure 2-7). Climate change was given the highest percentage (35%) of the LEED total points because of the built environment’s negative contribution to this problem. However, the economic and social Impact Categories were given the least importance with only 5%. Furthermore, the cultural component, which is included in the Sustainability Square previously discussed, was not included as an IC in itself.

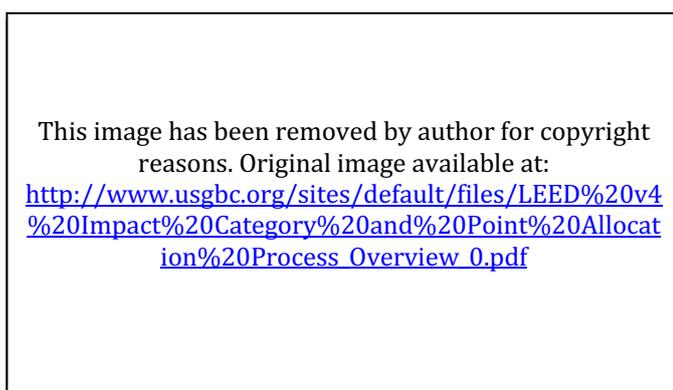


Figure 2-7: LEED version 4 Impact Categories weightings. These weightings (%) account for “differences in scale, scope, severity and relative contribution of the built environment to the impact” (Owens et.al., 2013: 6)

Table 2-1: LEED V4: DETAILED IMPACT CATEGORY (IC) AND COMPONENTS					
IC & DEFINITION	KEY INDICATORS	LEED INDICATORS OR METRICS REFERENCED	ND	SCHOOLS	
				NC	OM
<p>Enhance Social Equity, Environmental Justice, Community Health and Quality of Life:</p> <ul style="list-style-type: none"> ○ support the long-range vision for the future growth and community development ○ provide universally accessible economic opportunities, supports environmental justice and human rights, addresses issues of social equity, ○ improve quality of life ○ nurture cultural vitality ○ buildings can shape the culture, politics, values, prosperity, health, and happiness of citizens 	Create a Strong Sense of Place	light pollution reduction;	X	X	X
		tree-lined streets;	X		
		views;		X	X
		landscaping and green roofs;		X	
		open spaces;		X	
		civic spaces;	X		
		historic preservation;	X		
		connection to the outdoors;			
		walkable communities;	X		
		human scale environments;			
	cultural expression; freedom to express values/beliefs through building design				
	Provide Affordable, Equitable and Resilient Communities	affordable housing and jobs proximity;	X		
		mixed use;	X		
		universal design;	X		
		heat island reduction;	X	X	X
		open and dense street grids;			
	Promote Access to Neighborhood Completeness Resources	walkability; bikeability;	X	X	X
		proximity to diverse uses; mixed use;	X	X	
		community services and public transit;	X	X	X
		compact development patterns;	X		
		walkability; bikeability;	X	X	X
		open spaces and civic spaces;	X		
		parks and recreational facilities;	X		
		proximity to high quality public education facilities and resources;	X		
	Promote Human Rights and Env. Justice	natural resources protection;	X	X	X
		high performance and quality design of public buildings.			
		Reclaiming and repurposing vacant, obsolete or contaminated land and bldgs.;	X		
strengthening local and regional food supply chains;		X			
sustainable cleaning, purchasing and facility management policies;				X	
safe drinking water quality;					
indoor air and env. quality;		X	X		
support community	X				

		involvement through the provision of civic and public spaces;			
		designing climate adaptable and durable buildings			
Total indicators (38)			24	11	10
Percentage			63%	29%	26%
LEED systems key: ND: Neighbourhood Development; NC: New Construction; OM: Operations & Maintenance					

Table 2-1: Extract. Includes social Impact Categories and Components in LEED version 4. Table based on information in Owens et.al., 2013: 15-16. See Appendix A.

As shown in Table 2-1, within the *Social equity, environmental justice, and community quality of life* IC definition, there is a brief reference to how buildings impact culture. One of its key indicators is to *Create a Strong Sense of Place*, which focuses on developing more opportunities in the built environment to promote social interactions, creating a strong sense of identity, historical preservation, as well as “cultural expression and the freedom to express values/ beliefs through building design” (Owens et.al., 2013: 15-16). However, this definition states indirect measures such as light pollution reduction, tree-lined streets, among other LEED credits that do not have a direct impact on social and cultural aspects of a community. It is important to point out that the majority of the LEED indicators referenced in Owens (2013) and shown in Table 2-1, belong to the LEED for Neighbourhood Development (ND) system and are not included in LEED for Schools.

In contrast to LEED, other systems such as SB Tool and RESET include a larger amount of social and cultural specific indicators (Figure 2-8). Several school SAS include categories named as Social (SPeAR; GRIHA Prakriti; SBAT); Equity (LBC); Socioeconomic (TERI GRIHA, RESET); Social, cultural and perceptual aspects (SB Tool); Sociocultural and functional quality (DGNB) and Liveability (Green Star), among others, which makes evident at first glance that these factors are being considered.

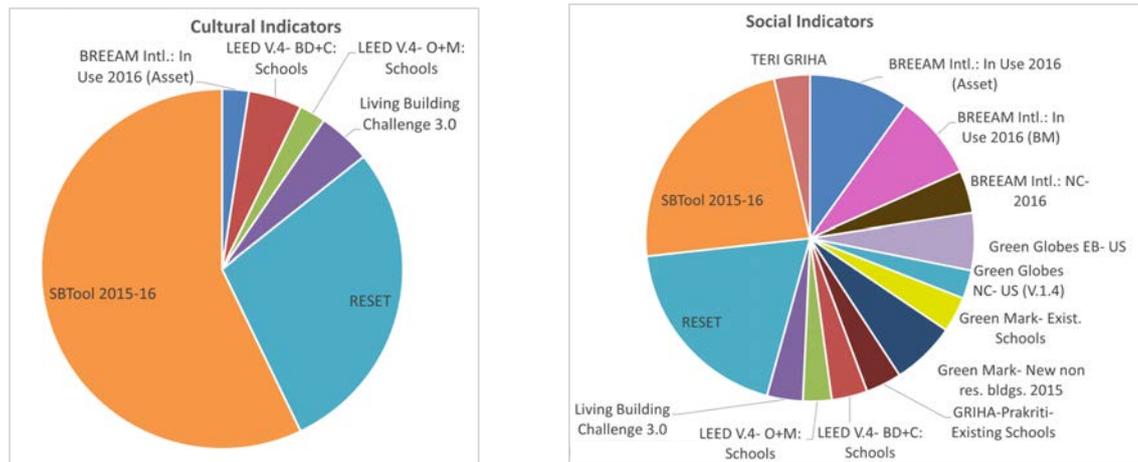


Figure 2-8: New Construction (Schools) certification systems that target Social and Cultural aspects. Certification systems for schools included in these charts: BREEAM International In Use & NC 2016; Green Globes US EB & NC (V 1.4); Green Mark Existing Schools & New non residential buildings 2015; GRIHA Prakriti Existing Schools; TERI GRIHA; LEED V4 BD+C & O+M Schools; LBC V3.0; RESET; SBTTool 2015-16. Chart by author.

The document *LEED v4 Impact Category and Point Allocation Development Process* (Owens 2013), recognizes that the system is not equally effective in targeting all Impact Categories. In order to determine LEED priorities and credit weightings, the following factors were taken into consideration:

- The built environment’s capability to solve the problem identified as part of the Impact Category
- The ability to measure the credit’s outcome
- Relative efficacy of a particular LEED credit; its benefits or consequences

First, LEEDs priorities were assigned based on the relative importance or perceived contribution of the built environment to solving the problem identified in the IC. In contrast to a building’s evident impact on issues such as Climate Change, “the effects resulting from other Impact Categories may be less severe, less certain, operate at a smaller scale or perhaps the built environment has less of an ability to solve the defined problem” (2013:6). This can explain the low value or percentage assigned to the social and economic issues, as perceived by the U.S. LEED Steering Committee. However, authors such as Vallance, question the relevance of social development for ‘First World’ countries, which already addressed basic development issues. Meeting people’s basic needs (food, safety, work, among others) everywhere, is a crucial part

of wider developmental goals. Furthermore, under-development can act as a barrier to securing better social and environmental outcomes (Vallance 2013: 343-344). While nations such as the U.S. have social policies in place to support societal and economic development, this might not be the case of all developing countries. Therefore, if SAS such as LEED are to be used internationally the inclusion of regionally adapted sociocultural and economic criteria are essential in order to become an effective measure for sustainability.

Second, the ability to measure the credit's outcome is another important factor. Impact Categories such as climate change can be measured quantitatively by determining a project's CO2 footprint, however metrics for qualitative categories such as social equity are not well defined by industry standards (Owens et.al., 2013: 6). This suggests the need to develop a methodology to assess social and cultural criteria.

Third, the relationship between LEED credit requirements and IC was analysed based on its relative efficacy, duration of its benefits or consequences and who are individuals responsible for ensuring that the credit outcome is achieved (Figure 2-9). For example, if the credit relies on building occupants, as opposed to the project team, then the certainty of achieving the outcome is lowest. This in turn reflects on a lower association weighting (Owens et.al., 2013: 8). This contradicts the idea of the user as an active component of a sustainable building, responsible for its maintenance and performance (Cole, 2008).

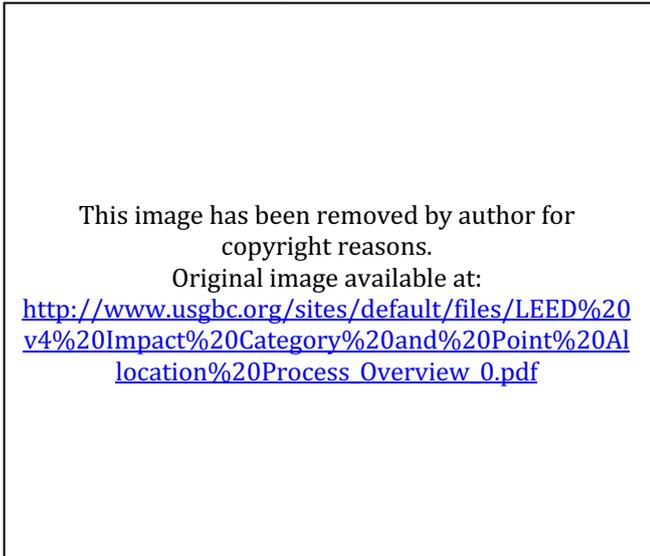


Figure 2-9: Sample assessment of LEED’s efficacy in addressing system goals (Owens et al., 2013: 10).

While LEED’s focus is on issues such as climate change, water and energy conservation, requires further development on the human health, social equity and community aspects (Owens et.al., 2013: 10). Other important aspects such as the cultural sustainability dimension need to be strengthened. According to Suzer, “the environmental impact of a building should be evaluated with regard to the local conditions and the related regional priorities and environmental concerns” (2015:267). When implemented, a sustainable assessment system should be flexible enough to adapt to the social, economic, cultural and environmental reality of the region.

2.2.2. USGBC Organizational Structure and LEED’s Regionalization Strategies

Efforts are underway to advance LEED to reflect contexts in countries outside the United States (Todd et al., 2013). In order to be more effective and improve global reach, the USGBC organizational structure has evolved since its creation in 1993 into a more decentralized approach, while several regionalization strategies such as Climatic Location, Regional Priority Credits (RPCs), Alternate Compliance Paths (ACPs) and Pilot Credits, have been implemented (see Figures 2-10; 2-11).

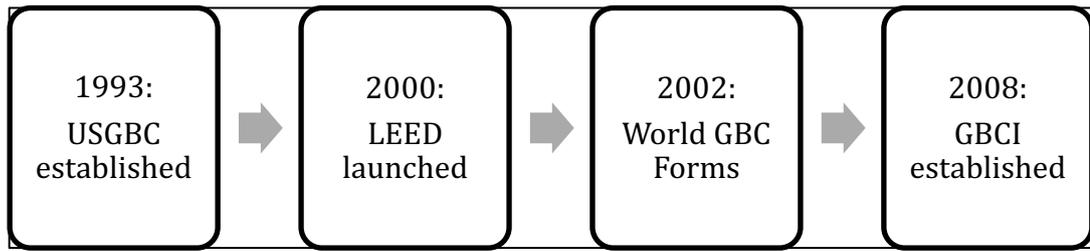


Figure 2-10: USGBC organizational structure- timeline (Everblue Training, 2015).

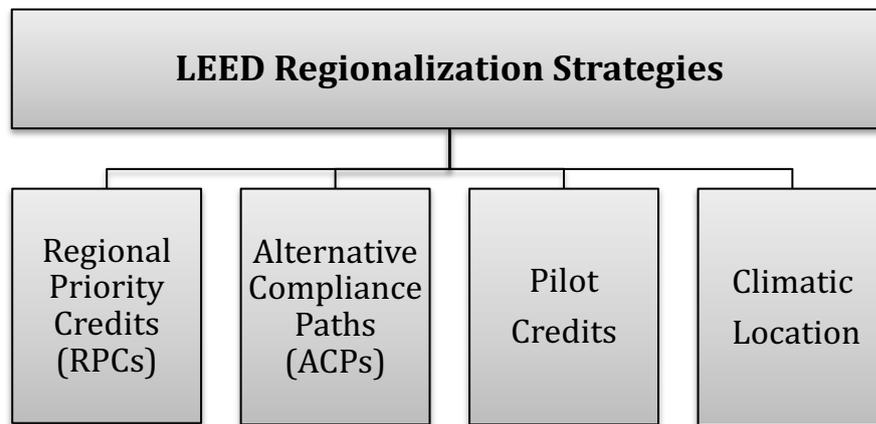


Figure 2-11: LEED Regionalization strategies. Chart by author.

A significant development in the evolution of the USGBC organizational structure was the creation of the Green Building Certification Institute (GBCI) in 2008, currently known as the Green Business Certification, Inc. While the GBCI became responsible for the administration of the LEED certification, the technical review of registered green buildings, and the professional credentials system, the USGBC focused on developing and refining LEED standards, and strengthening advocacy, research, educational programming, the online Green Building Information Gateway and local chapters within the U.S. (Cole and Valdebenito, 2013; World GBC, 2016; USGBC, 2016c; Green Building Academy, 2016) (see Figure 2-10).

With the establishment of the World Green Building Council (WGBC) in 2002, a network of national green building councils from around the world started to form. Currently, over one hundred countries are part of this council, making it the world's largest international organization influencing the green building marketplace (World GBC, 2016). Within this group, the U.S. Green Building Council under the America's Regional Network represents Puerto Rico despite the climatic, social and cultural

differences with the U.S. mainland. However, P.R. shares similar characteristics with other Latin American and Caribbean countries under the America’s network due to its Hispanic background. The difficulty being that each of these Latin American countries has their own representative, while P.R. is represented solely by the U.S. (see Figure 2-12).

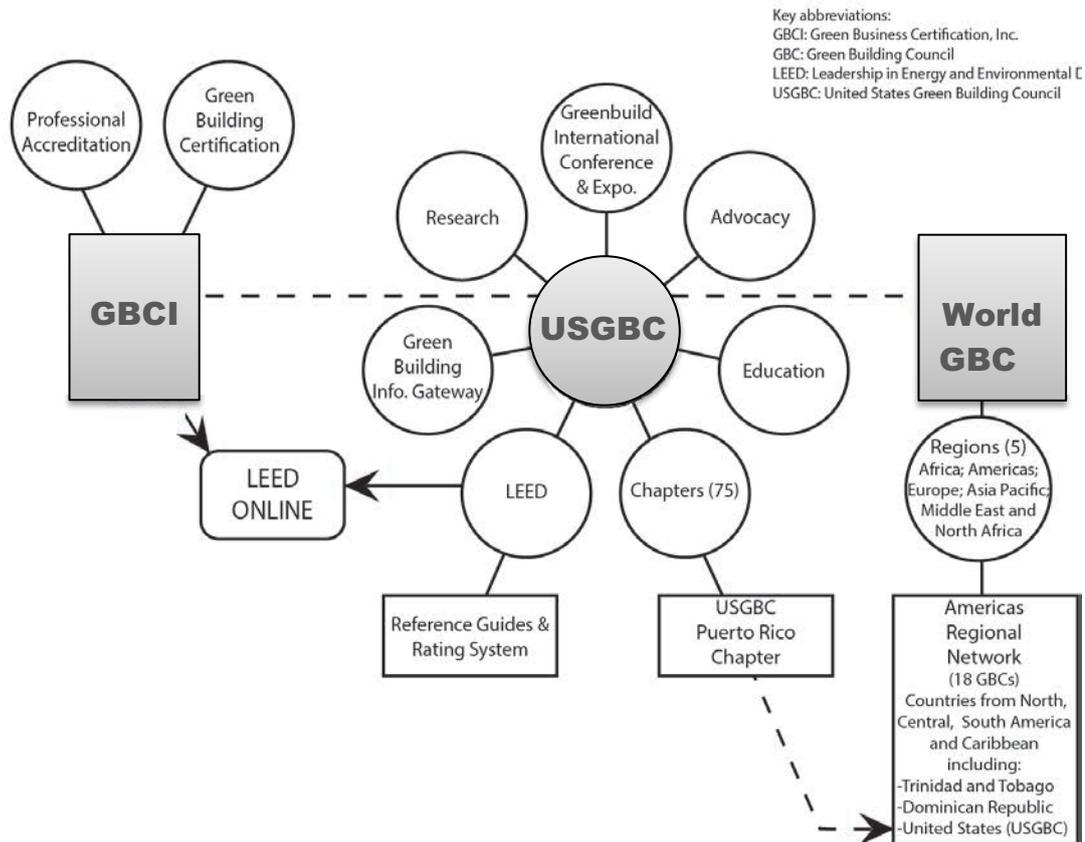


Figure 2-12: Relationship between USGBC, GBCI and World GBC. Data sources: (World GBC, 2016; USGBC 2016; Green Building Academy 2016). Diagram by author, April 2016. The USGBC develops and publishes LEED requirements and oversees advocacy, research, educational programming, the online Green Building Information Gateway and local chapters within the U.S. GBCI, its sister organization, is a 3rd party that administers LEED and oversees the technical review of registered green buildings, as well as professional credentials. The LEED Online tool for building certification is used by both the USGBC and GBCI. The World GBC is a network of building councils in more than 100 countries and Puerto Rico is represented by the USGBC, within America’s Regional Network.

A similar organizational structure is utilized within the LEED International Roundtable (LIR), where the U.S. Green Building Council represents the P.R. Chapter. The LIR advises the USGBC regarding LEED’s global application and adoption. Composed by representatives from Green Building Chapters and leadership

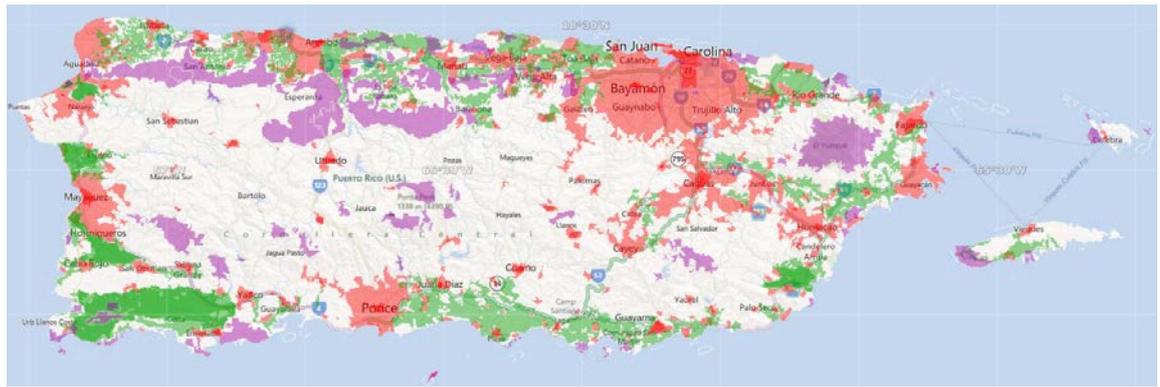
organizations in over 40 countries, it has been involved in the development of regionalization strategies such as Regional Priority Credits (RPCs), Alternate Compliance Paths (ACPs) and Country-specific versions, which will be discussed in the upcoming sections (USGBC 2016).

2.2.3.1. Regional Priority Credits (RPCs)

The Regional Priority Credit category, introduced in LEED 2009 allows project teams to earn bonus points by demonstrating compliance with the priority credits identified for a specific location. These credits, selected by the LEED International Roundtable and volunteers from green building chapters around the world, target environmental issues that affect their particular region or country (Díaz-Lamboy et al., 2017: 404; USGBC, 2016e, USGBC, 2016f).

In Puerto Rico, a task force within the USGBC Caribbean Chapter determined regional issues, environmental zones and priority credits (Rodriguez 2012). However, critical issues identified by the group focused only on environmental considerations such as: land use and mobility, water and materials use, as well as indoor environmental quality and thermal comfort.¹² As a result, the majority of the RPCs selected for P.R. are located within the Sustainable Sites and Location and Transport categories (USGBC, 2021a). Furthermore, social, cultural and economic dimensions could not be considered because RPCs only recognize compliance of existing credits, and these were not included in LEED.

¹² Regional Priorities for P.R. included the following categories and credits: Sites: Lack of Agricultural Soils, Impaired Watersheds, Endangered Species & Ecosystem Protection; Location & Transportation: Excessive Automobile Usage, Poor Land Use and Urban Sprawl; Water: Excessive Water Use; Materials & Resources: Waste Management; Indoor Environmental Quality: Thermal Comfort.



■ Urban Sprawl
 ■ Prime Agricultural Reserves
 ■ Environmentally Sensitive Zone

Figure 2-13: P.R. map indicating regional priorities (Source: Rodriguez, 2012).

As shown in ■ Urban Sprawl ■ Prime Agricultural Reserves ■ Environmentally Sensitive Zone

Figure 2-13, the Geographic Information System (GIS) tool was used to represent layers for environmental issues such as urban sprawl, prime agricultural reserves and ecologically sensitive zones within the P.R. map (Rodriguez 2012), which are easily plotted by using this technology. Furthermore, Appendix B illustrates the specific RPCs selected for the Island. However, in order to measure cultural considerations, new assessment strategies are necessary and will be developed as part of this research.

2.2.3.2. Country-specific Versions and Alternative Compliance Paths (ACPs)

In addition to RPC's both LEED Country-specific versions and Alternative Compliance Paths (ACPs), developed in collaboration with the International Roundtable and green building chapters, attempt to adapt LEED to the local context. At first, Country-specific versions, that include LEED Canada (2004), LEED India (2007) and LEED Italia (2009) were created under license with the USGBC (Horst 2014). However, these schemes kept the original LEED categories and only made minor alterations to credits and its weightings, and substituted references to U.S. environmental and building regulations with each country's standards, programmes and system of measurement (Ozolins, 2010: 54, CaGBC, 2016a). These alterations do not meaningfully address social and cultural dimensions.

The USGBC transitioned from country-specific versions to a standardized, uniform system (LEED v4) with interchangeable sections. In 2009, the USGBC developed Alternative Compliance Paths (ACPs) to recognize differences in climatic conditions, codes, standards and laws applicable to projects outside the U.S. (Horst, 2014).

In addition to reference substitutions to U.S. standards and programs, ACPs in India comprise, for example, paths relevant to climate, location and available technology.¹³ Further countries with ACPs include Canada, East Asia, Europe and South America. LEED projects in all other countries outside the U.S. can refer to the Global-ACPs version, which can be applied at the discretion of the project team based on its relevance for the site location. Even though projects in Puerto Rico can use some of these Global-ACPs, no specific paths were developed for the Island (Díaz, 2016; USGBC, 2009a).

However, both country specific versions and ACPs are mainly focused on replacing technical aspects such as modifying weightings and standards on particular indicators, while LEED criteria remains the same for all countries. Considering that P.R. references U.S. standards and building codes, ACPs would not be an effective strategy to locally adapt LEED. According to Taylor (2012: 7), ACPs provide a “one size fits all scheme”, making it “impossible to anticipate every situation in which LEED might be implemented”. Even though overall consistency would be achieved, the recognition of local social, cultural and economic conditions in LEED indicators would need to be strengthened (Díaz-Lamboy et al., 2017: 404). In contrast to LEED, other systems such as the SB Tool (iiSBE, 2015) consider all sustainability dimensions, while allowing more flexibility for project teams to add or eliminate indicators depending on a country’s priorities.

2.2.3.3. Pilot Credits and Innovation in Design Category

¹³ For instance, the alternate path for the Water Efficient Landscaping credit amends the baseline water use to account for year-round plant irrigation in tropical and sub-tropical regions. Evaporative condensers were also included under the Cooling Tower Water Management credit because of this technology’s efficiency in dry climate countries such as India (USGBC, 2014a).

Projects may pursue Pilot Credits (PC) within the Innovation in Design Category. This regionalization strategy allows teams to test criteria in the PC Library developed by others or submit new credits (USGBC, 2016f). All proposals are then evaluated by the Pilot Credit Committee (PCC) and approved by the LEED Steering Committee (Díaz-Lamboy et al., 2017: 404, USGBC 2016).

An analysis of existing Pilot Credits can give valuable insight about trends and new criteria proposed by project teams. For instance, the majority of the PC for LEED BD+C are related to the Materials and Resources category (33%), however a smaller percentage of credits (15%) belong to the Innovation category (Díaz-Lamboy et al., 2017: 404, USGBC 2016) (see Figure 2-14). It is relevant to acknowledge that this category includes criteria that target social issues such as:

- Green training for contractors, trades, operators and service workers
- Social equity within the community
- Social equity within the project team
- Prevention through Design
- Integrative Process for Health Promotion

Four (4) out of the six (6) credits target social equity and user safety. However, there is no mention of any cultural aspects. The only economic criteria is located within the sustainable sites criteria, a proposed credit titled *Informing Design Using Triple Bottom Line Analysis* which requires projects “to demonstrate the economic, social, and environmental value of LEED design strategies using empirical evidence to inform the design process” (USGBC, 2016). To comply with this criterion, the project team must develop a benefit-cost analysis on at least six (6) LEED credits.

The above-mentioned Pilot Credits suggest an interest and need for LEED to target additional sustainability dimensions, particularly social aspects. As result, the USGBC’s LEED Steering Committee created a Social Equity Working Group to improve the practical implementation of the above-mentioned Social Equity Pilot Credits (USGBC, 2015). According to Todd and Kaplan (2014), the adoption of these

credits by the USGBC signals the green building movement’s maturing and evolution. “Fostering Social Equity” became a guiding principle in the USGBC’s strategic plan (2013-15) and new goals developed for LEED’s version 4 that aim to “enhance the life of all people involved in a project”, including construction workers, design and construction professionals, users, and the community. Considering that the social and cultural sustainability dimension should be strengthened, the Pilot Credit Library may be a valuable tool to propose new LEED criteria and test its effectiveness. This could eventually trigger the creation of a Sociocultural Working Group to further develop relevant indicators (Díaz-Lamboy et al., 2017: 405).

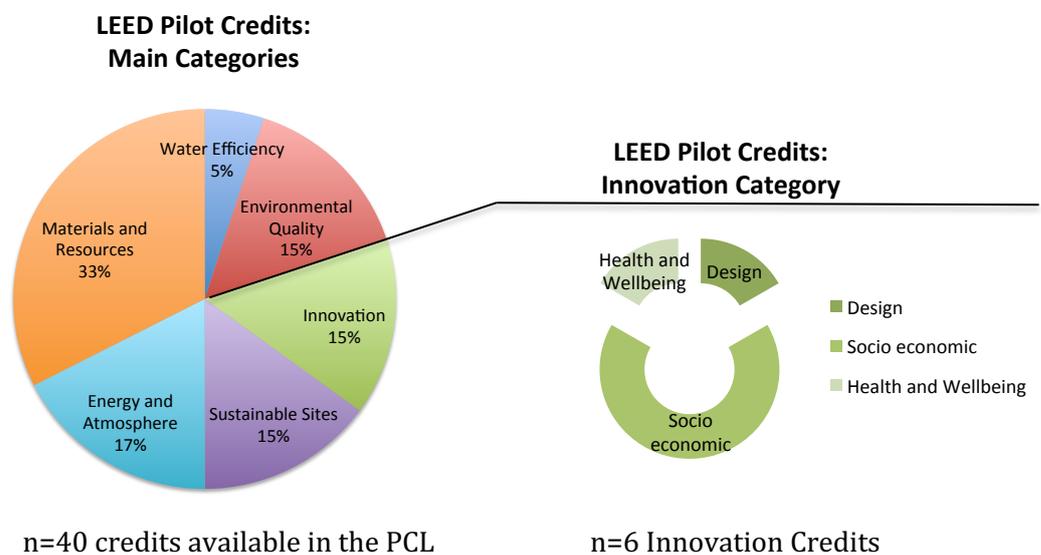


Figure 2-14: LEED Pilot Credits: Main Categories. USGBC 2016. Chart by author.

It is important to point out that on LEED version 4.1, the concept of “social equity” was included within the *Integrative Process* and the *High Priority Site and Equitable Development* credits, which demonstrates awareness and positive impact of the proposed PCs, which permeated into the system’s credits.

2.2.3.4. Climatic Location

LEED references the Climate Zone Classification Map under the American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 90.1 to consider climatic differences between countries. Energy and Atmosphere criteria such as the prerequisite *Minimum Energy Performance* and the *Optimize Energy*

Performance credit both use this classification to establish design strategies and recommendations by climate zone (USGBC 2016).

LEED presupposes that ASHRAE energy standards have relevance in the context it is being applied (Ozolins 2010: 107). However, variances between energy usages in the different climate zones may greatly influence building envelope design. Some of the strategies appropriate for cold climates, where both heating and cooling systems are necessary in buildings, may not be suitable for tropical climates due to the warm outdoor temperature and high humidity (Bay and Ong 2006; Ozolins 2010: 107).

Regional climatic variations impact a country's landscape, architectural form and materiality, which in turn affect the way social and cultural activities are carried out, and vice versa. Schools in temperate climates like the U.S., favour the use of glass panes, steel and brick, while most schools in P.R. since the 1950's Tropical Architecture movement¹⁴, are built in concrete due to propensity for natural disasters such as fire, hurricanes and earthquakes (Rodríguez Rivera, 2014). Deep overhangs control light entering the buildings, while operable windows provide alternate natural ventilation to lower energy costs (P.R. Senate and House of Representatives, 2008). Puerto Rico's tropical climate favours year-round use of open amphitheatres, courtyards or patios in schools (Fielding Nair International, 2010), in contrast to other temperate climates, which require alternate indoor spaces to carry out social and cultural activities during fall or wintertime.

The tropical climate favours the use of passive strategies such as natural ventilation, building orientation and daylighting, among others in order to promote energy efficiency, greater connection with the outdoors, and user wellbeing (Daud, 2020:55). However, the LEED Manual provides guidance mostly for targeting energy efficiency and indoor air quality in naturally ventilated spaces, while SAS such as Green Mark (GM) and RESET, developed specifically for the tropical region place

¹⁴ The Tropical Architecture Movement is an adaptation of modern design and construction trends for the tropical climate and lifestyle. This style is characterized by open and semi-open spaces, balconies, as well as passive design strategies such as natural ventilation, the use of *brise soleils* (sun screens) and deep overhangs (Bay and Ong, 2006).

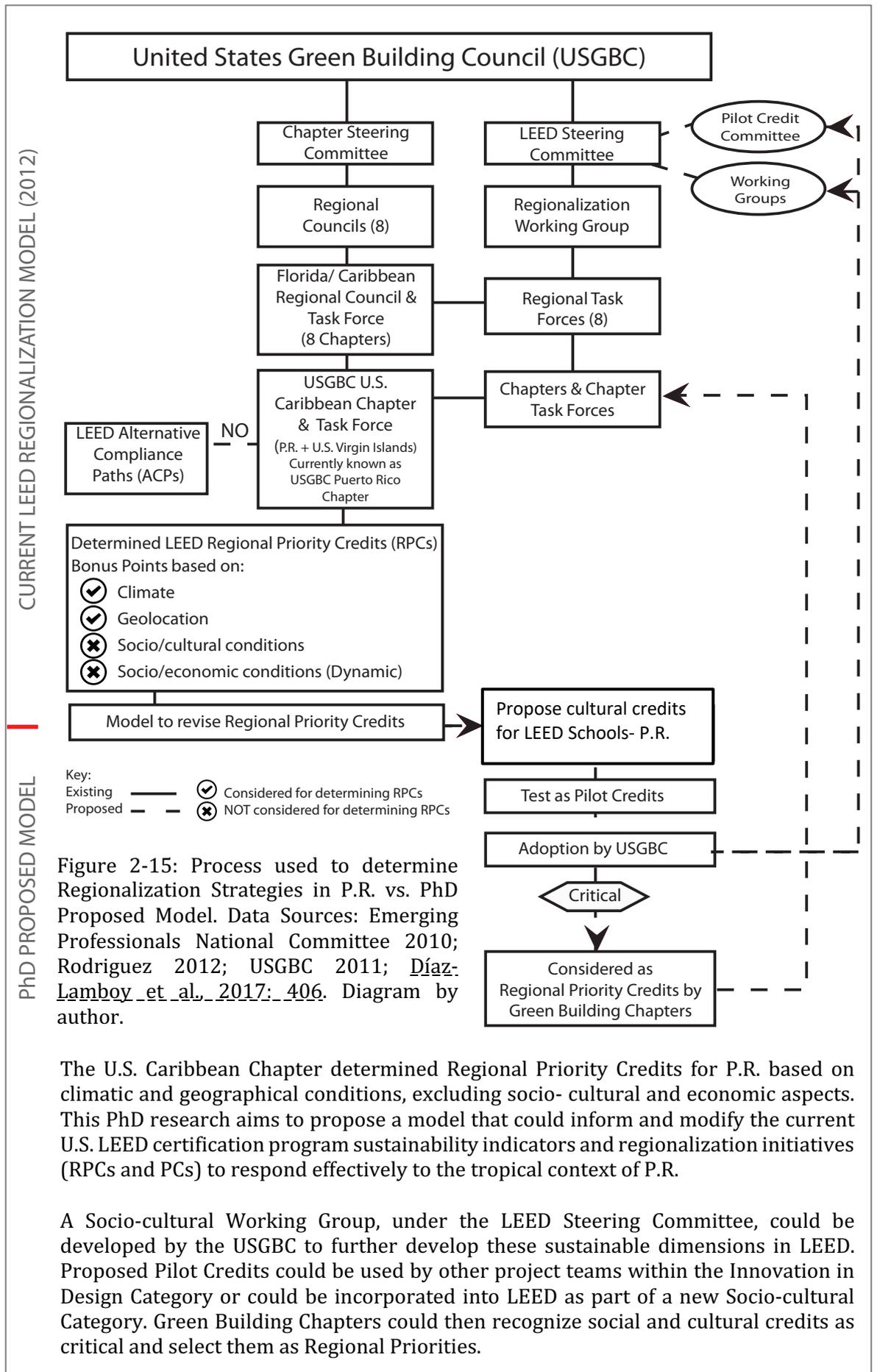
great emphasis on design strategies. GM, for example, includes a Tropicality section, which is focused on the project's spatial quality and building envelope performance (Rodríguez Rivera, 2014). RESET, on the other hand, emphasizes on architectural form as means to achieve sustainable buildings. It focuses on spatial quality and user experience rather than on energy efficiency, while encouraging the design of pro-environment spaces that support social interaction (UIA, 2012).

2.3. Implementation Proposal and Preliminary Conclusions

Through these past sections, it has been demonstrated that LEED's main focus to date is on targeting the environmental dimension of sustainability, while socio-cultural aspects need to be strengthened (RO1). Recent initiatives by the USGBC demonstrated that the social dimension is already being targeted by adding this concept as one of LEED's seven (7) system goals for version 4 (Owens, 2013:2); through new credits in the Pilot Credit Library, and the creation by the USGBC of a Social Equity working group to further develop these criteria. Also, through the integration of the "social equity" concept into two (2) of LEED indicators. Recently, in LEED V.4.1, indicators in the Location and Transport and Sustainable Sites Category (High Priority and Equitable Development and Site Assessment, respectively) aim to promote community engagement and the assessment of site conditions, including social factors, to inform design decisions (USGBC, 2021:21.53). While early stages of the research explored both social and cultural dimensions, later decided to focus only on the cultural one which is less developed in LEED. Even though a brief reference to culture is made on the *LEED v4 Impact Category and Point Allocation Development Process* document (Owens 2013) that underpins LEED, there are no indicators in LEED for Schools that target this dimension. Internationally, trends in SAS such as RESET, SB Tool, among others, which include cultural criteria, are a complement to organizations such as the UNESCO who advocate for a multi-dimensional sustainable development.

After demonstrating the need for LEED to target the cultural sustainability dimension, its regionalization strategies were analysed in order to determine the

best approach to adapt the system for countries in tropical regions (RO2). As illustrated in Figure 2-15, the USGBC local chapter, formerly known as USGBC Caribbean, determined Regional Priority Credits based solely on climatic and environmental conditions in P.R., which is LEED's main focus. Since Regional Priority credits were selected from existing indicators, no cultural factors were considered or mapped using the geolocation tool.



In order to strengthen the cultural sustainability dimension, this research will focus on the development of new indicators and the revision of existing ones that respond to the tropical region, utilizing Puerto Rico as case study. The Innovation category presents a bottom-up approach, in which practitioners can propose PC, based on the needs and opportunities identified in their projects. This could be a starting point to test the proposed indicators product from this research, developed for the LEED for Schools, Building Design and Construction and Operations and Maintenance systems. For example, professionals can utilize the proposed credits available on Appendix X (Chapter 8) and submit them under the Innovation in Design category for evaluation by the USGBC during their project certification process. This could lead to the development of a working group to further develop these cultural indicators, as it happened with Social Equity credits, which were later incorporated into LEED v4 (Sokol, 2014). Furthermore, this could target the creation of a new LEED Socio-cultural category that will allow regional chapters such as USGBC P.R. to select these indicators as Regional Priority Credits (see Figure 2-15).

The next chapter will analyse the role of culture in sustainable development and determine how this dimension is assessed in LEED. Furthermore, will provide a necessary theoretical background to contextualize the application of LEED in the Island and define its culture. Results from the research will inform the development of context- specific indicators that eventually could become part of the LEED SAS.

Chapter 3: Assessing Culture in LEED Through a Postcolonial Lens

3.1. Introduction

The previous chapter justified the need for strengthening and adding cultural indicators in the LEED for Schools system (New Construction and Existing Buildings-Operations and Maintenance) and proposed an implementation strategy to fill this gap.

This chapter will explore the role of culture for sustainable development by referencing the sustainability square (Ebert 2011:21, Mateus and Bragança 2011:1962), as well as Soini and Dessein (2016: 4) conceptual framework model. Also, will analyze in depth the LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013: 2) initially presented in Chapter 2, particularly the *Enhance Social equity, environmental justice, community, and quality of life* IC which includes a brief reference to how buildings impact culture. This analysis presented in section 3.2 will inform how culture is assessed in LEED and contribute to identify what aspects of sustainability in the tropical Caribbean P.R. region could be incorporated as indicators, as expressed in research objective 3 (RO3).

Section 3.3 will define and discuss several key terms identified in Owens et al. (2013: 2), including cultural vitality, sense of place and cultural identity expression. In order to understand how a designer's cultural beliefs/intentions were expressed in local school designs, this research will also reference Postcolonialism and Henri Lefebvre's third space theories. The following research sub-questions guided the literature review process:

- Can postcolonial theories be applied to the Island to understand its social, cultural, environmental and economic context? What concepts are relevant for P.R.?
- How was architecture used as a vehicle to transmit and build a national cultural identity in P.R.?

- How is P.R.'s hybrid culture expressed in its architecture? (Third space)

The answers to these questions will be presented in sections 3.4 and 3.5. Section 3.4 presents an overview of the postcolonial movement and legacy in the modern world, as promoted by South Asian theorists such as Homi K. Bhabha (1994) and Gayatri Spivak (1988), building up on concepts by Michel Foucault (2005, 1980), Edward Said (1978) and Frantz Fanon (2004, 1967). Although postcolonial theories were originally applied in the literature and cultural studies field, these have been further extended to other disciplines such as architecture (Hernandez, 2010; Peters, 2017: 2). Also, its postulates have been adapted by Latin American scholars, including P.R. theorists such as Luz M. Rodríguez (2013).

Section 3.5 analyses several postcolonial concepts as it applies to P.R.'s context, cultural identity, discourse and nation building through architecture, including:

- Hybridity as identity
- Schools as cultural spaces

Both cultural identity and architecture in P.R. have been subject to external/international influences from pre-Hispanic, Hispanic and American colonial periods that have shaped its existing culture. The combination of these elements has resulted in a "hybrid" culture; term coined by postcolonial theorist Homi K. Bhabha (1994).

This investigation identifies the local sustainable LEED certified educational facilities, particularly the Schools for the 21st Century Project in P.R. as an example of hybrid architecture on the Island. Also, recognizes tropical architecture as a precedent for the sustainable movement in P.R., which emphasizes mainly on passive strategies such as shading, natural ventilation and daylighting, to achieve energy efficiency. Current sustainable architecture includes these strategies but also adds imported technologies, mainly from the U.S., to attain efficiency. The LEED system was used to certify these schools, without any adaptation to the tropical context, its culture or recognition of its hybridity, as will be explored through this investigation. Furthermore, section 3.6 includes the conceptual framework developed for this research, which summarizes the concepts discussed in the

literature review and was used as reference to develop the methodological strategy for this study.

3.2. Culture for Sustainability in P.R.

For the purpose of this study, culture is defined as the characteristics of a society, its norms, values, skills, knowledge, beliefs and aspirations that serve as a guide for an individual or group to construct regional identities (Axelsson et al., 2013:217; Dessein et al., 2015:xiv; Hawkes, 2001:3; Walker, 2014:6). It can manifest itself through intellectual or artistic creativity, while individuals, organizations or institutions are responsible for its dissemination (UNESCO, 2001). Culture could also be interpreted as “way of life”, including its “customs, faith and conventions, codes of manners, dress, cuisines, language, arts, science, technology, religion, rituals, regulations of behaviour and traditions” (Hawkes, 2001:3).

Sustainability models such as the “sustainability square”, include culture as the fourth pillar, alongside the social, economic and ecological dimensions (Ebert 2011:21, Mateus and Bragança 2011:1962, Culture 21, 2011:2; Agenda 21, 2008:5). Furthermore, theorists such as Katriina Soini and Joost Dessein explored the relationship between these pillars and proposed three roles of culture in sustainable development, namely *culture in...*, *culture for...* and *culture as...* (2016: 4). As shown in Figure 3-1, the *culture in* sustainability model portrays culture as the fourth independent pillar, complementary to ecological, social, and economic sustainability, in contrast to *culture for* sustainability, where culture acts as mediator between the other dimensions. Lastly, *culture as* sustainability, depicts culture as foundation, necessary to achieve the overall aims of sustainable development.

This image has been removed by author for copyright reasons.
 Original image available at: <http://www.culturalsustainability.eu/conclusions.pdf>

Figure 3-1: Three roles of culture in sustainable development (Dessein et al., 2015b: 29)

This research will use and further develop the *culture in sustainability* model as a starting point considering certification systems such as LEED, RESET and SB Tool, among others, include few cultural indicators to the system that are still independent from the other pillars. Worldwide, most indicators (66%) in mainstream SAS for schools in temperate and tropical climatic regions (LEED, BREEAM, LBC, SB Tool-Green Mark, GRIHA Prakriti, TERI GRIHA, RESET), are focused on targeting negative building environmental impacts. User related social (16.2%) and cultural aspects (4.8%) are considered in some systems but are still a minority (Figure 3-2).

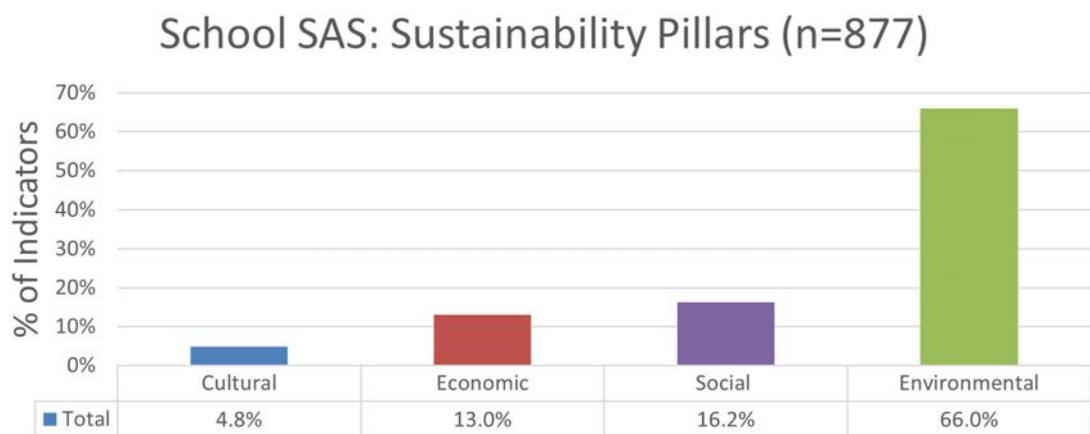


Figure 3-2: Indicator benchmark considering SAS for schools worldwide (n=877 indicators). School certification systems included in this analysis: BREEAM International In Use & NC 2016; Green Globes US EB & NC (V 1.4); Green Mark Existing Schools & New non residential buildings 2015; GRIHA Prakriti Existing Schools; TERI GRIHA; LEED V4 BD+C & O+M Schools; LBC V3.0; RESET; SBTool 2015-16.

However, this research aspires to contribute to the progression of the LEED SAS towards the *culture for sustainability* model, where this sustainability pillar has a central mediating role to achieve economic, social, and environmental dimensions. Once this short-term goal is reached, the next step would be to pursue *culture as sustainability*, in which culture becomes the foundation of sustainable development. The cultural dimension is linked to the economic pillar through income generation and employment; it also relates to social programs that deal with poverty, human rights, health and wellbeing, and civic engagement. Furthermore, it is associated to the environmental dimension through the use of cultural capital to raise environmental consciousness (Scammon, 2012). Culture “frames people’s relationships and attitudes towards the built and the natural environment”, affecting all aspects of building construction and operations (Scammon, 2012).

According to Kashima (2020), humans must develop new cultures of sustainability to reduce our environmental impact, prevent ecological devastation and sustain global human well-being. In his view, culture is a dynamic process through which information is socially transmitted between individuals. A society’s environmental policies, social norms and cultural values influence human’s relationship with the natural environment and dictate the boundaries of what decisions are reasonable and acceptable for people to make (Armstrong and Staff, 2021). For example, the greenhouse gas emissions and the decrease in carbon sinks produced by energy-intensive lifestyles, diets, and changes in land use are one of the main causes of climate change. Cultural sustainability may inform which practices need to be modified and those that should be retained by a society for future generations to come (University of Helsinki, Climate University and Una Europa, 2022). Therefore, the inclusion of culture in sustainability has been given significant importance worldwide by organizations such as UNESCO, as evidenced in the 2030 Sustainable Development Goals (2019).

To contribute to the attainment of *culture for sustainability* as a first step, this research will focus on the development of new cultural indicators to better adapt the

system for Puerto Rico's context. The inclusion of cultural sustainability indicators in SAS could promote user awareness and modification of current environmentally harmful practices and lifestyles. Additional strategies to promote a more prominent role of culture in LEED and its integration within its current structure include:

- Revision of existing credits to strengthen their cultural dimension, including those that target mainly other sustainability pillars. Specific credits will be selected in collaboration with design and construction professionals of case study schools.
- Development of new pilot credits that also consider relevant socio-economic and environmental aspects that promote cultural vitality in schools, recognizing that all dimensions are intertwined.
- Many of the proposed pilot indicators promote the development of culturally adequate buildings to strengthen user "sense of belonging" which could help promote individuals' pro-environmental behaviours and involvement in the building's planning, design, operations and maintenance phases.
- Cultural sustainability requires collective action and citizen participation in coordinated activities to achieve a common goal, another recurrent topic in the proposed pilot indicators and existing credit revisions. It is important that building users and the surrounding community have the opportunity to participate in the discussion of culture, define the cultural heritage to be protected, express their views and ideas, and participate in their implementation (University of Helsinki, Climate University and Una Europa, 2022).

3.3. Assessing Cultural Vitality in LEED

The LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013: 2), referenced on the previous chapter, includes seven (7) Impact Categories that seek to answer what a LEED project should accomplish. The next sections will particularly analyse in-depth the *Enhance Social equity, environmental justice, community, and quality of life* IC which aims to:

Support the long-range vision for the future growth and development of community that provides universally accessible economic opportunities, supports environmental justice and human rights, addresses issues of social equity, improves quality of life, and **nurtures cultural vitality**. This category explores the importance that buildings have in the context of the greater community that surrounds them, and how they can powerfully **shape the culture**, politics, values, prosperity, health, and happiness of the citizens that are unavoidable affected by them. (Owens et al., 2013: 15)

Owens, et.al. (2013: 15) states that a sustainable building should improve the quality of life of its users and nurture **cultural vitality**, while identifying **Sense of Place (SoP)** as its main component, as summarized in Table 3-1. Also, mentions diverse measures or indicators that contribute to SoP in an attempt to quantify or qualify the abstract concept of culture for the built environment:

To create a strong sense of place in communities by focusing on human-scale environments that allow for seamless interaction and engagement of citizens with their environment and each other. A stronger sense of place provides means creating more opportunities for cultural, social and recreational interactions, improving community aesthetics, creating a strong sense of **identity** with the community and a greater sense of connectivity between members of that community. Examples of measures that contribute to sense of place include: light pollution reduction, tree-lined streets, quality views, ecologically-conscious landscaping, green roofs, open spaces, civic spaces, historical preservation, greater connection to the outdoors, pedestrian friendly communities, human scale environments, **cultural expression and the freedom to express values/beliefs through building design**. (Owens et al., 2013: 16)

Table 3-1 aligns the above-mentioned measures with its corresponding LEED system. Indicators such as historic preservation and the provision of civic spaces are included in LEED for Neighbourhood Development but could also be considered for inclusion under LEED for Schools. Other indicators found in literature review related to “cultural vitality in communities” (Rosario Jackson et al., 2006: 4) include aspects such as cultural participation and governance that are missing from LEED.

LEED V4: ENHANCE SOCIAL EQUITY, ENVIRONMENTAL JUSTICE, COMMUNITY HEALTH AND QUALITY OF LIFE IMPACT CATEGORY AND COMPONENTS					
IMPACT CATEGORY & DEFINITION	COMPONENTS	MEASURES THAT CONTRIBUTE TO SoP	ND	SCHOOLS	
				NC	OM
Enhance Social Equity, Environmental Justice, Community Health, and Quality of Life: <ul style="list-style-type: none"> ○ nurtures cultural vitality ○ buildings can shape the culture, politics, values, prosperity, health, and happiness of citizens 	Create a Strong Sense of Place (SoP)	light pollution reduction;	X	X	X
		tree-lined streets;	X		
		views;		X	X
		landscaping and green roofs;		X	
		open spaces;		X	
		civic spaces;	X		
		historic preservation;	X		
		connection to the outdoors;			
		walkable communities;	X		
		human scale environments;			
		cultural expression: freedom to express values/beliefs through building design			
LEED systems key: ND: Neighbourhood Development; NC: New Construction; OM: Operations & Maintenance					

Table 3-1: LEED V4: Enhance Social Equity, Environmental Justice, Community Health and Quality of Life Impact Category and Components. Table by author, emphasizes on the cultural aspects in LEED referenced in Owens et.al., 2013: 15-16. See Appendix A.

Even though the concepts of vitality and SoP are included in one of LEED’s IC, they are neither defined nor referenced on the rating system guide (USGBC, 2016g) or its indicators. Therefore, for the purposes of this study it was important to study and analyse examples and definitions of cultural vitality in places such as Zakariya and et. al.’s (2016:229), which emphasizes on **the distinctive identities and sense of place that generate opportunities (spaces and activities) for cultural participation, social interactions and economic development**. This definition is aligned with LEED’s IC but, in addition, includes the concept of identity in juxtaposition to SoP, as an essential component or prerequisite to achieve cultural vitality. Recognizing the school’s identity and sense of place will help to determine its uniqueness and significance (Zakariya and et. al.: 2016). We propose the following equation to summarize this concept:

$$\text{Cultural vitality} = \text{identity} + \text{cultural spaces with a strong sense of place}$$

The Urban Institute's Arts and Culture Indicators Project (ACIP)¹⁵ developed indicators that envision **cultural vitality** as "the evidence of creating, disseminating, validating, and supporting arts and culture as a dimension of everyday life in communities" (Rosario Jackson et al., 2006: 4). While this definition recognizes culture as an integral part of everyday life in communities, it can also be useful for schools, as these are part of communities and a community in itself (Milofsky, 2018: 437). With the availability of new materials, technologies, and techniques due to globalization, there is a risk of spaces becoming generic and losing intrinsic cultural qualities during school modernization processes. This research will examine P.R. schools' tangible and intangible cultural qualities so that it can strengthen or support its cultural vitality through its use and renovations.

The ACIP served as precedent for developing indicators that aim to strengthen cultural vitality. The project identifies three domains and proposes metrics for arts and culture based on quality of life measurement systems, these are:

- presence of opportunities for cultural participation: focuses on the availability of cultural spaces, events, organizations, and districts, as well as cultural diffusion and communication
- cultural participation in arts education, activities and events
- support for arts and cultural activities: cultural economy, public expenditure on culture; volunteering; governance; public policies about arts and culture.

After analysing relevant literature on **cultural vitality** (Rosario Jackson et al., 2006; Zakariya and et al., 2016) it is possible to identify seven (7) components: Cultural spaces and events; Cultural heritage; Education; Communication; Inclusion and participation; Governance and Cultural economy. Even though this research focuses on culture because it has been the most neglected in LEED, it acknowledges that all sustainability dimensions are intertwined by including environmental, social, and economic considerations applicable to this pillar. Research findings point to a

¹⁵ The ACIP develops quantifiable measures to document arts and culture in communities. This information can be useful for researchers, practitioners, and policymakers that want to know about the presence and role of arts and culture in communities and their impact in neighborhood conditions and community dynamics (Rosario Jackson et al., 2006: 5).

relationship between cultural vitality components such as Cultural heritage and Cultural spaces with the environmental culture. In this sense, the attainment of building sustainability goals may be linked to user’s awareness of energy, water and resource conservation. For example, if energy saving practices are embedded in the school user’s culture, this may promote less energy consumption in buildings. Furthermore, in P.R., the use of passive design strategies as a cultural response to climate and the environmental context has been part of the Island’s architectural heritage and tradition since the Spaniards (PRSHPO and Pabón Charneco, 2010: 58). Also, exterior open spaces in local schools have great potential for hosting cultural and learning activities, considering the tropical climate (Fielding Nair International, 2010: 12).

The above-mentioned cultural vitality components were used in this study to (re)categorize SAS indicators into these subcategories for analytical purposes, as will be further discussed in Chapter 6 (Figure 3-3). Also, to develop a list of cultural indicators for design and construction professionals of LEED certified schools to prioritize based on their relative importance for cultural vitality in the Island. In the following sections, we will analyse LEED’s culture-related IC components and measures, namely SoP, cultural identity, and expression which are key to achieve cultural vitality in the built environment.

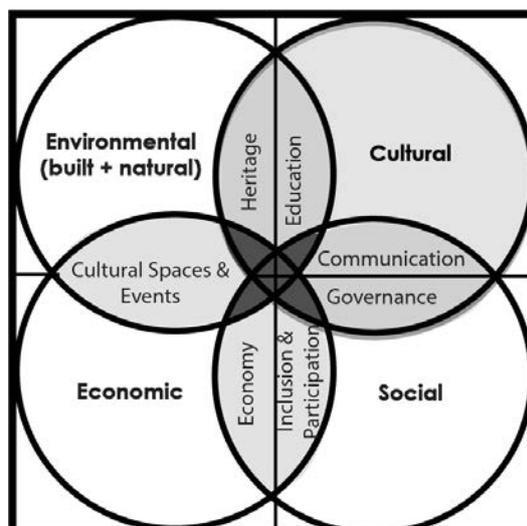


Figure 3-3: Sustainability Dimensions & [Re]categorization of Indicators in SAS. Diagram by author.

3.3.1. Sense of Place or Placemaking

One of LEED's key components is to *Create a Strong SoP*, which focuses on developing opportunities to promote social interaction while creating a strong sense of identity with the community (Owens et al., 2013:16). The concept of SoP was developed in architecture and urbanism theories in the 1960s and 1970s to describe how individuals and/ or groups perceive, shape, value, appreciate and are attached to places. Individuals develop their own notions of SoP, often drawing on past experiences to assign meaning to these spaces (Scannell and Gifford, 2010:5). The character or uniqueness of a particular locality usually emerges from its historical, cultural and environmental settings (European Cooperation in Science and Technology, 2020).

SoP was taken a step further in contemporary urban research through the concept of Placemaking (Carmona et al., 2010). According to the Project for Public Spaces, Placemaking aims to strengthen the connection between people and places, focusing on citizen ownership and capitalizing on local community assets. Furthermore, it advocates for an inclusive design process, promoting community participation as a strategy to include "social, cultural or ethnic groups in the process of re-shaping their environment and landscape" to make it more appealing and useable (European Cooperation in Science and Technology, 2020; Project for Public Spaces, 2009). Community participation in design processes may result in the likelihood of producing projects that are acceptable to a wider community, have greater support and impact. Also, it may become an enabler of new connections and networks between community members, while strengthening their sense of pride and belonging (Malone, 2019). Placemaking strategies offer an opportunity for community members "to create environments that are meaningful, manageable, and comprehensible" and promotes that people take better care of their spaces (Ellery and Ellery, 2019).

Therefore, we propose substituting SoP with Placemaking as an operational concept because it portrays an active user, involved in the making of place and its own culture. Placemaking "facilitates creative patterns of use, paying particular attention to the physical, cultural, and social identities that define a place and support its

ongoing evolution” (Project for Public Spaces, 2009). It aims to create spaces that promote people’s health, happiness, and wellbeing (Project for Public Spaces, 2009), which is also one of LEED objectives as mentioned in Table 3-1.

Wyckoff’s definition of Placemaking includes SoP as: “Quality places with a strong sense of place that people want to work, live, play and learn in” (n.d.). He enumerates key elements of quality places which include green spaces, quality public spaces, preservation of historic structures and community heritage, walkable communities, human scale environments, among others. These are also mentioned on Owens et al. (2013), as measures that contribute to Sense of Place, as illustrated on Table 3-1. This makes Placemaking a valid term to be included in LEED.

The Project for Public Spaces (PPS) developed the *Place Game* which serves as a diagnostic exercise to evaluate Places in four categories: 1) Access and linkages; 2) Sociability; 3) Uses and activities; as well as 4) Comfort and image. This user-friendly tool was selected because of its simplicity, which allows the user to rate the different qualities of places from poor to good and identify opportunities for improvement. A modified and adapted version of this tool was developed and used in the survey for design and construction professionals discussed in chapter 7 with the objective of building a ‘cultural profile’ of schools in P.R. This research instrument or assessment tool was employed to determine which architectural elements, and Placemaking strategies contributed to the expression of Puerto Rico’s culture in educational buildings.

3.3.2. Cultural Identity and Expression

Culture influences people’s identity; building design, use and operation, heritage conservation, as well as user’s sustainable practices, among other aspects. Culture impacts how sustainability issues are viewed and approached in different contexts and situations. Also, influences human behaviour, attitudes, worldviews and their interaction with the environment (Berglund et al., 2020: 6288). Whereas buildings provide spaces for activities such as socializing, culture diffusion, learning, practicing rituals and showcasing art (Ettehad et al., 2014).

The concept of cultural expression as referenced in Owens, et al. (2013) focuses on how **culture shapes buildings**. He mentions that the “freedom of architects/designers to express values/beliefs through building design” is one of the measures that may contribute to SoP. This is aligned with the anthropological perspective that views design as a culture making process in which ideas, reference values and beliefs are spatially and symbolically expressed in the environment to create new cultural forms and meanings (Kent, 1984; Low, 1988:187). The building, in turn, influences or shapes user culture, behaviour, space use and sustainable practices.

In order to understand how a designer’s cultural beliefs/intentions were expressed in local educational building designs, this research references Postcolonialism and Henri Lefebvre’s Third Space theories, as will be further explained in the next sections. These theories were employed to investigate the relationship between P.R.’s cultural identity, colonialism and its manifestation in sustainable architecture to determine what cultural aspects of sustainability in the tropical Caribbean region are excluded from LEED but could be incorporated as indicators (RO3).

3.4. Postcolonialism Overview and Legacy in the Modern World

This section will explore if postcolonial theories can be applied to the Island to understand its social, cultural, environmental and economic context. Postcolonialism deals with the legacy of Western colonialism, conquest and colonization of the Americas by Spain, other European nations and the U.S. (Young, 2016:4). It began as an academic discipline in Western Universities (particularly those in England and the U.S.) during the 1960s. Early Postcolonial theorists were mostly “Third World” refugees; sons or daughters of foreigners and immigrants; or University graduates mostly from Asia, the Middle East, and India, whose names include Homi K. Bhabha and Gayatri Spivak, among others (Castro-Gómez, 1998:27-28).

In academic circles, Postcolonialism is mainly linked to former English and French colonies that became independent during the mid-20th century. However, there has been a debate regarding whether postcolonial theories can be applied to former Spanish colonies in America, including P.R. This is because most of Spain’s former

colonies were already independent when Postcolonial theories emerged¹⁶ (Thurner and Guerrero, 2003:25). Also, there is a continuation of colonial forms in “postcolonial countries” of the Americas because these did not re-institute power to the native indigenous populations, instead, these were seized by dictatorships, local elites or Western powers, which was the case of P.R. that became a U.S. protectorate after the Spanish-American War (1898) and its Commonwealth in 1952¹⁷ (Duany, 2017; Young, 2016:xxi).

Peter Hulme, emeritus literature professor at the University of Essex, U.K., emphasizes on the possibility of “[...] reading and living different types of (post) colonialities. Even if American countries do not fit in the postcolonial discourse, we can talk about decolonization, colonial discourse or postcolonial theory with reference to the continent” (1995: 119). He expressed, “[...] as seems inevitable... if postcolonial studies is the name that is going to hang over the gate, then let us use the word in a way that includes America” (Hulme, 1995: 123). This research argues that postcolonial theories can be applied to the L.A./ Caribbean context and were influential in the theoretical development of the region¹⁸.

¹⁶ Most American colonies obtained their independence during the late eighteenth and early nineteenth centuries (1776-1820), except Cuba which obtained its independence in the early twentieth century (1902). However, countries in Asia, the Middle East, and India attained their independence after World War II, between 1945 and 1960 (Young, 2016:35,42).

¹⁷ The Commonwealth status allowed for political, environmental, social, cultural and economic autonomy in local matters, including: governmental elections, law creation, taxation, economic development, education, health, housing, culture and language. However, the U.S. federal government would remain in control of state affairs such as: citizenship, immigration, defence, currency, transportation, foreign trade and diplomacy, among others. Previously approved legislation that granted U.S. citizenship, welfare benefits and access to federal funding remained (Duany, 2017a).

¹⁸ Before postcolonial theories emerged, anti-colonialist literature/ discourses were already being developed in L.A. during the 19th century, to promote its independence from Spain, affirm its identity and distinctive cultural traditions, as demonstrated by Cuban philosopher José Martí writings. After WWII, L.A. theorists such as Leopoldo Zea and Enrique Dussel supported the Philosophy of Liberation movement in Argentina that critiqued the predominance of Euro-American imperialism, globalization, racism, sexism and neocolonialism¹⁸. They aimed to promote unity amongst L.A. countries and affirm its culture already existed before the New World discovery (Mendieta, 2007; Williams, 2016).

The influence of postcolonial theories in Latin America (L.A.) was felt amongst local theorists and Latinos teaching in U.S. universities. For example, academics Walter Mignolo, Santiago Castro-Gómez, and Ramón Grosfoguel were members of the Latin American Subaltern Studies (LASS) group that emerged in 1992¹⁹. This group, inspired by its South Asian Subaltern Studies counterpart, critiqued the national historiography in their respective countries because it was written from a Eurocentric or American perspective (Grosfoguel, 2007).

The literature review revealed that postcolonial theories had a great impact on L.A. anti-colonial literature, which included adapted postcolonial concepts and/or produced alternate theories such as the Decolonial approach, by Walter Mignolo (2012) and Anibal Quijano (2000). Both postcolonialism and decoloniality theorize about the production of knowledge in the colonial world (Tlostanova, 2019:165). However, while the first focuses on the geopolitical and historical colonial condition, the latter studies the remnants of colonialism that still affect independent countries worldwide (Tlostanova, 2019: 165; Bhabra, 2014: 119). P.R. theorists such as Ramón Grosfoguel (2011, 2007, 2003), Andrés Duany (2017a, 2017b) and Luz Marie Rodríguez (2013) have also studied the impact of colonialism on the country's history, as well as the continuation of colonial forms in the present while attempting to define an identity separate from that of the colonizer.

The Island has been described as a “post-colonial colony” by theorist Andrés Duany (2002) and “modern colony” by sociologist Ramón Grosfoguel (2003:2), to label P.R.'s political relationship with the U.S. The Commonwealth arrangement includes benefits such as metropolitan citizenship, access to financial markets, as well as technological and welfare transfers. Its status contrasts with Caribbean islands such as Cuba, Dominican Republic, and Haiti, among others, that may be considered “neo-colonies”, since they attained their independence but without “decolonization”. These republics experience the exploitation of the capitalist world- system without

¹⁹ The South Asian and Latin American Subaltern Studies group met in October 1998 at a conference held at Duke University, which resulted in several publications in the journal *NEPANTLA*. This event's critiques, debates and discussions eventually gave rise to discursive variants that arose within the group (Grosfoguel, 2007:211).

the benefits of a “modern colony”²⁰. Decolonial theories have a prospective approach and advocate for a second decolonization process to address socio-cultural and economic relations in previously colonized countries that attained juridical and political independence (Grosfoguel, 2003:15).

While this thesis recognizes that there are different theoretical viewpoints regarding P.R.’s current political status, it has identified the postcolonial lens as the base or root for the subsequent anti-colonial, decolonial literature and discursive variants that emerged. Also, recognizes the influence of postcolonialism in local theorists and applicability to analyse the local architectural production. For example, Luz Marie Rodriguez discusses postcolonial theories to analyse the Caribe Hilton²¹ hotel design (1949). This project employs the International Style to represent an image of “international sameness” and attract foreign investment, however, it was adapted for the local context through the use of passive design strategies that convey the idea of “tropicality” as identity (2013).

Similarly, Tropical architecture’s passive design concepts from 20th century architecture are still used today as reference for the Island’s sustainable design practices. This was evident in the educational institutions designed under the Schools for the 21st Century Project, that include interior patios, open corridors, *brise-soleils*, operable windows for natural ventilation, among others, complemented by imported active technologies. Postcolonial theories were employed in this thesis to explain/ understand the local cultural identity formation process during the different colonization periods until the Island’s current status as a Commonwealth. While the creation of P.R. as Commonwealth keeps strong links with the U.S., it paved the way for the definition of P.R.’s identity “post-colony”.

²⁰ This “coloniality” or continuity of colonial forms of domination is evident in transnational corporations that exploit the periphery. Also, through U.S. involvement in the International Monetary Fund (IMF), World Bank, among other transnational institutions that provide financial aid to developing countries to support its development. However, these organizations never intervene in P.R.’s affairs because of its status as a Commonwealth or “modern colony” (Grosfoguel, 2011:15).

²¹ This project was designed by the architectural firm Toro, Ferrer and Torregrosa.

This research argues that Postcolonial theories in L.A., the Caribbean and P.R. were adapted and transformed through acts of “cultural translation”. In his book *The Location of Culture*, Bhabha uses this concept to emphasize on the role of the translator as an intermediary, located in-between different cultures (Bhabha, 1994:247). Bhabha not only refers to the translation of terms and concepts into a different language, but also to the meaning and symbolism of those words in different cultures. Some words can’t be faithfully translated, requiring some level of subjectivity from the translator, where his own references and context play an essential part in the interpretation of the original work (Bhabha,1994:53; Hernandez, 2010:28). This act of resistance to complete integration or assimilation will be explored both theoretically and architecturally.

The next sections will discuss the adaptation of postcolonial theories in P.R. A country with a hybrid culture due to a myriad of influences since it has been subjected to more than 500 years of colonialism; 405 years under Spanish rule and almost 120 years under the U.S. dominion, while also being subjected to influences from Latin America and the Caribbean due to its geographical location.

3.5. Postcolonial Theories Adaptation in Puerto Rico: Cultural Identity, Discourse and Nation Building through Architecture

This section presents the analysis of several postcolonial concepts applicable to P.R.’s context including cultural identity construction and its corresponding expression in local architecture. Cultural identity refers to the sense of belonging of an individual or group with a common origin, history, ancestry, characteristics and/or ideals (Hall and Gay, 1996: 2). Identities are temporal and may change and evolve depending on historical events, variations in the mainstream discourse or ideologies, among other factors:

[...] identities are constructed within discourse [...] produced in a specific historical and institutional sites within specific discursive formations and practices, by specific enunciative strategies. Moreover, they emerge within the play of specific modalities of power, and thus are more the product of the marking of difference and exclusion [...] (Hall and Gay, 1996: 4).

Postcolonialist authors critique the traditional historical narrative which discusses historical events from the colonizer's standpoint while emphasizing on the colonized and its identity formation process. Western colonizers produced knowledge and constructed the identity of less developed countries as a form of control (Said, 1978:20). Bhabha employs Foucault's (1980) theories to explain how cultural colonialist **discourse** excludes what is social, racial and culturally different and may pose a threat to the homogeneous constitution of a nation (Bhabha, 1994:156-158).

Similar to Europe, U.S. imperial institutions started to define and disseminate knowledge about "third world" countries in L.A. with two distinct theoretical focus: L.A. as **underdeveloped or exotic "other"** (Mendieta, 2007:102). Following Bhabha's theories, Rodriguez identifies the discourse of "tropicality" as a colonial expression; a means to fabricate the identity of P.R. as the U.S. "other" (Rodriguez, 2013: 178.)

U.S. development policies regarding the "third world" were accompanied by financial aid programs for the modernization of these countries and their conversion into the American "way of life". U.S. territories such as P.R., became a democracy showcase, part of the political struggle against the expansion of communism in L.A. (Castro-Gómez, 1998: 30). To achieve this goal, local governor Luis Muñoz-Marín and his administration used discourse as tool to build and define P.R. as a nation associated to the U.S., while preserving its Pre-Hispanic and Hispanic character (Duany, 2003:435).

This "cultural nationalism" or "state sponsored identity" helped to strengthen the individual and collective sense of belonging, by defining Puerto Rican symbols such as the Spanish language, heritage buildings, the image of the "jíbaro"²², Indigenous legacy, popular arts (wood carving- saints), myths, memoirs, rites, flag, among others (Duany, 2003:436). This may be interpreted as an example of what Bhabha denominates as the codification and valorisation of symbols. He argues that

²² "Jíbaro" refers to P.R.'s countryside traditional farmers.

“[...]symbols of culture have no primordial unity or fixity; signs can be appropriated, translated, rehistoricized and read anew” (Bhabha, 1994:55). During the 1950s, symbols that were reminiscent of the Indigenous and Spanish colonial past were reconfigured to justify the territorial relationship with the U.S.

The process of *transculturation*²³ (1995) impacted the historical, cultural, political and economic aspects of the country. This nascent *Puertorriqueñista* colonialism defined a strong hybrid culture that was supported and disseminated through museums, schools, among other governmental institutions (Grosfoguel, 2003:61). Architecture played a key role in supporting P.R.’s governmental cultural discourse by materializing the idea of progress and modernity brought by the industrialization era. P.R.’s architectural identity was defined by the Committee on the Design of Public Works (1943-1948) in collaboration with foreign architects, such as the Austrian-American Richard Neutra and German-born Henry Klumb, that created their interpretation of what “Tropical Architecture” should be. The Committee was responsible for the implementation of new building technologies and materials, as well as the design of standardized building prototypes for the construction of industries, hospitals, schools, housing, libraries, sports facilities, among other typologies, in both urban and rural contexts (Gala Aguilera, 2007:25-26). Imported Western architectural models such as the International Style were adapted for the tropics, to establish an image of “international sameness” to attract foreign capital investment and tourism (Rodriguez, 2013: 170). Despite the fact that the Committee lasted only five (5) years, local architects continued promoting and further developing the Tropical Architecture style. Design professionals culturally translated imported technologies and construction methods to the local context into a hybrid style that synthesized European and American influences up to that period.

3.5.1. Hybridity as Identity

In the colonial context, cultural hybridity is produced when the *self* and the *other* are

²³ Cuban theorist Fernando Ortiz uses the concept of *transculturation* to describe the process of mutual transformation and influence of different cultures in the historical, cultural, political and economic aspects of his country.

inseparable from each other; when elements from different cultures are fused together as part of a Subject's identity (Wolf, 2000:13). Cultural differentiation, then, becomes a sign of authority by the colonized and a way to challenge the dominant power (Bhabha, 1994:112). Roberto Segre and Bruno Stagno identify Tropical Architecture as an example of *Caribbean Environmental Syncretism*, the particular combination and interaction that generated an architectural system suited for the tropics, the idiosyncrasy of its population, its values and identity caught between the popular culture and Modernity (Tzonis et al., 2001:115).

Some academics have argued that postcolonial architecture in Latin America reproduced imported styles, only varying building materials and adapting to local climatic conditions, through the inclusion of architectural elements such as *brise-soleils* (Real and Gyger, 2013:5). However, this architecture expressed regional diversification by combining modernism with different styles according to each country's history and identity. For instance, in pre-Columbian civilizations such as Mexico or Peru, architecture included a hybrid mix of native expressions with colonial tendencies (Vieda Martínez, 2017: 5). In Puerto Rico, hybridity became part of the visual and spatial expression of identity.

Even though Puerto Rico's architectural history, has been marked by the adaptation or cultural translation of imported architectural styles since the first colonization period by the Spaniards, this research identifies the Tropical Architecture style, as the epitome of hybridity in the Island. Tropical architecture's passive design concepts from the 20th century are still used today as reference for the Island's sustainable design practices. This was evident in the design and construction of LEED certified educational institutions whose architects (n=10) were mainly influenced by modern architecture (60%), tropical architecture (50%) and the international style (30%) for their school projects, as revealed on a multi-answer question on the online survey performed for this research (2020) (Chapter 7). These federally funded schools were designed following international guidelines developed by an American company and evaluated using the LEED SAS, which still hasn't been culturally translated for the local context. Professionals employed hybridity as a response to LEED requirements

by complementing passive sustainable techniques adapted to the local context with active imported technologies.

3.5.2. Schools as Cultural Spaces

Schools are one of the most important vehicles to introduce and reinforce cultural values in a society, while selectively transmitting the knowledge, norms and values determined as appropriate. This research identifies schools as **third spaces or liminal spaces**, which promote the encounter between Subjects or groups with different traditions and background in an on-going negotiation and cultural translation (Bhabha, 1994:5). Post colonialists such as Bhabha employ the third space concept to refer to a liminal space, “in-between the designations of identity”, which opens up the possibility of a cultural hybridity in the recognition of difference (Bhabha, 1994:5). Therefore, schools become spaces of cultural learning, exchange and manifestation.

Bhabha employs the third space concept as a spatial metaphor. However, what is missing in his analysis is the need to characterize or define the qualities of this abstract space. To further the application of the third space concept into architecture, this research referenced French Marxist Sociologist Henri Lefebvre (1901-1991). In *The Production of Space* (1991), Lefebvre argues that space is a social construction, dependent on a specific time and place. To explore this interconnection, he brings together various types of space modalities within a single theory known as the Conceptual Triad (Lefebvre, 1991:16,33), which may be summarized as:

- First space: **Perceived space**
 - Spatial practice: Refers to the physical space where social relations occur.
- Second space: **Conceived space**
 - Representations of space: Discusses the mental or conceived forms of space as conceptualized by the design team, including architects, engineers, planners and urbanists, among others.

- Third space: **Lived space**
 - Representational spaces: Social or lived space by inhabitants and users. Spaces are lived through its associated objects, images and symbols.

Therefore, spaces, as social constructions, are conceived by the designers' minds, then perceived, inhabited, and appropriated by its users.

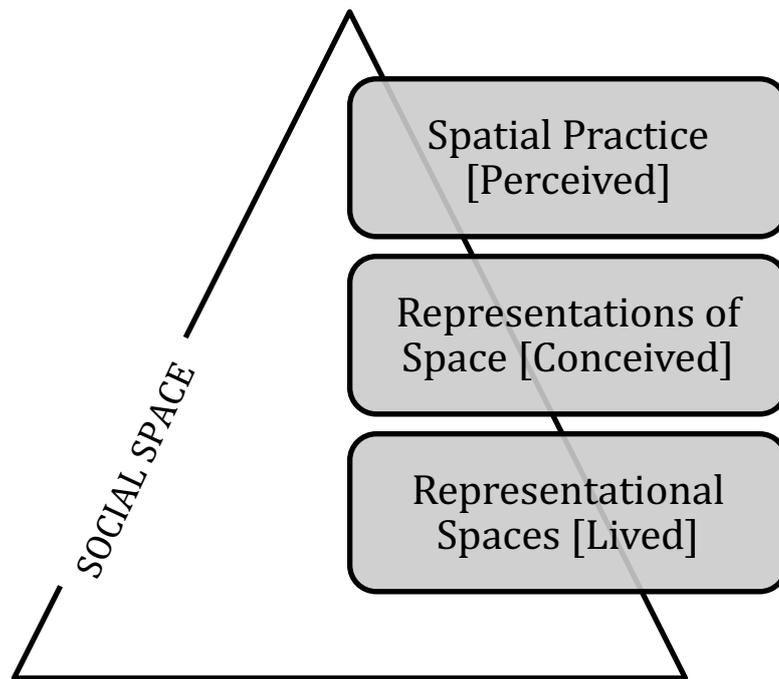


Figure 3-4: Lefebvre's Conceptual Triad (1991), graphic representation by (Campbell, 2016).

Lefebvre's Conceptual Triad in Figure 3-4 may be adapted for the P.R. context to explore identity construction through schools, as will be further explained on the next section. In P.R., schools have served as a space to diffuse the hybrid national identity discourse, which has been subject to political influences or beliefs. Schools have been instrumental in spreading cultural values during the Hispanic and American colonial periods and even today, where the Pre-Hispanic, Hispanic and American cultural values coexist and permeate through the built environment and curriculum.

3.6. Conceptual Framework

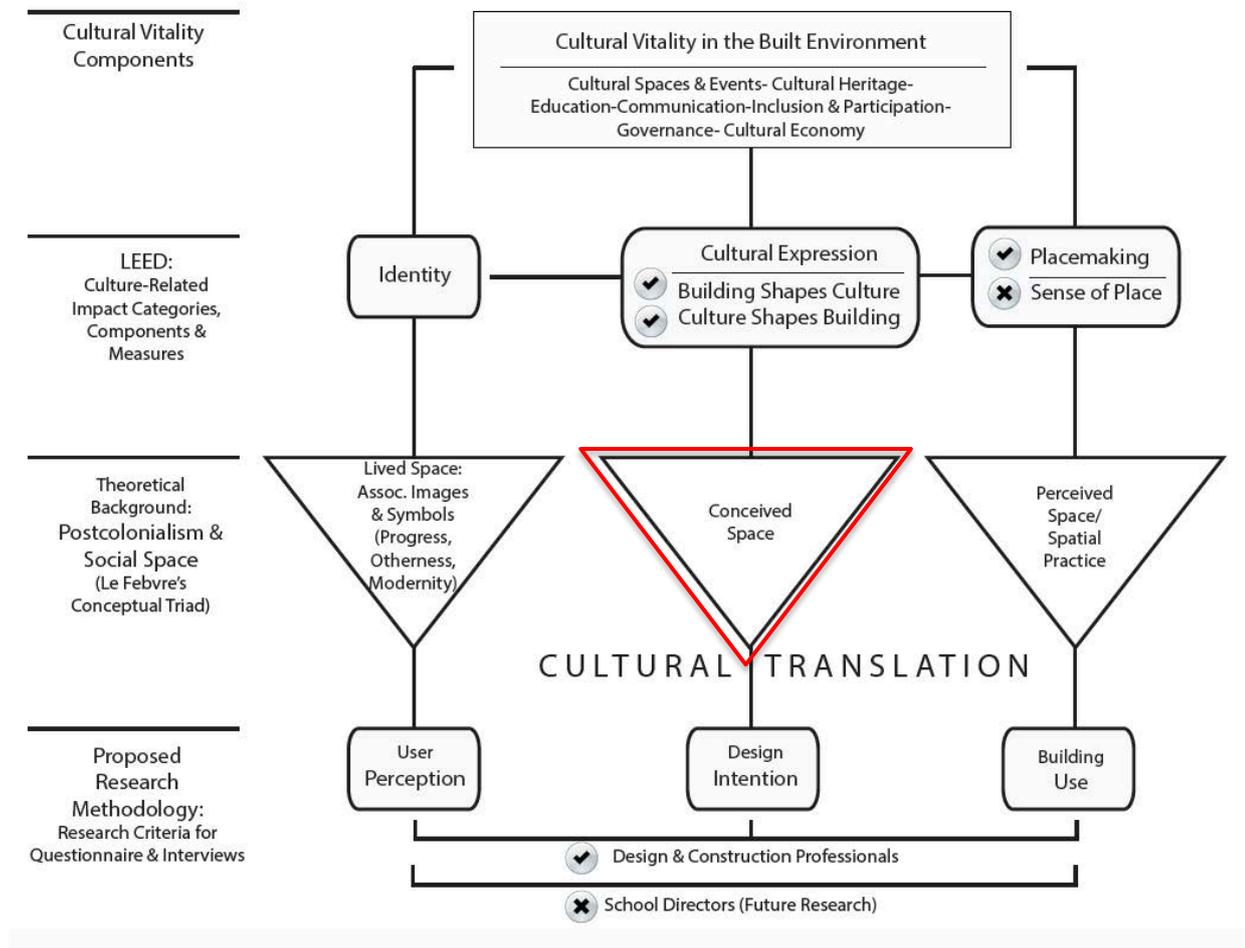


Figure 3-5: Conceptual framework diagram by author. Based on the analysis of postcolonialism, third space theories, and LEED’s IC, a conceptual framework was developed to guide the methodological strategy used to determine which indicators/ aspects should be included for the context of P.R.

Based on the analysis of postcolonialism and third space theories, as well as LEED’s IC, a conceptual framework diagram was developed to guide the methodological strategy used to determine which indicators and aspects should be included for the context of P.R. As illustrated on Figure 3-5, cultural vitality became the main concept or “umbrella” for the research and includes the following seven (7) components identified through literature review (Rosario Jackson et al., 2006; Zakariya et al., 2016): Cultural spaces and events; Cultural heritage; Education; Communication; Inclusion and participation; Governance and Cultural Economy.

The conceptual framework also reflects the link between cultural vitality and key components identified in the LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013), including identity, cultural expression and Sense of Place. The diagram emphasizes on the use of Placemaking strategies that facilitate user involvement in the making of place and its own culture, while also strengthening community's Sense of Place, as established in section 3.3.1.

To operationalize the concept of schools as third spaces, this research references Lefebvre's conceptual triad which includes lived, perceived and conceived spaces, emphasizing on the latter. This research will analyse the space "conceived" by design and construction professionals (architects, engineers, and sustainability consultants) of case study schools. The next paragraphs will discuss how each element of the triad applies to the local context and how it informed the proposed research methodology.

Conceived spaces may include school architecture; its buildings, and spaces which are designed and developed considering:

[...] architects' interests, developers' economic expectations and planning laws, while also being continually re-signified by users. Certainly, buildings provide the physical spaces where people perform and negotiate their differences. Even though buildings are inert, they are not culturally static; they express those narratives of conflict between peoples (users), power, technology and social change (Hernandez, 2010:21).

According to Adam Sharr (2012: 3), buildings are cultural artefacts that display the values involved in its design, procurement, construction, habitation and use. Buildings can give information about the culture and professional habits of the individuals who participated in their development. Therefore, buildings, details and related construction documents can be "read" for cultural insights (Sharr, 2012: 3).

Architecture has been used to organize people's lives and show power, while communicating ideological meaning (Sharr, 2012:6). This can be seen in the case of P.R. where public school projects after the 1940's aimed to civilize Puerto Rican citizens and communicate the governmental message of progress. The school

prototypes developed by the Design Council (1943-48), which included foreign architects such as Klumb and Neutra in collaboration with local ones, were designed in a metropolitan modernist style adapted for the tropics. Schools became ideological spaces, where otherness and tropicality became part of P.R.'s architectural identity and cultural expression.

Even today, the DEPR mandatory use of the LEED "infrastructure" in local school projects can also be interpreted as a postcolonial strategy, to continue promoting the image of progress and international sameness with other developed countries using the system. The "infrastructure" concept comprises "standards and ideas that control everything from technical objects to management styles", also the rules that govern the space of everyday life. These promote the development of reproducible and generic products and buildings worldwide (Easterling 2016:9). This concept is relevant to better understand Lefebvre's abstract (conceived) space, which is constituted by the intersection of knowledge and power, in which infrastructures are located. In his view, it pertains to those who wish to control the social organization and the space of everyday life (political rulers, economic interests, planners) (Pierce and Martin, 2015:1293).

This research will investigate design and construction professionals' cultural adaptation of the LEED "infrastructure" requirements and strategies employed to resist or challenge the system while complying with the certification requirements. Research findings revealed that even though professionals were responding to foreign criteria mainly developed for temperate-climate countries, continued to employ passive design concepts suitable for the local climate even though these were not recognized in LEED. This study will also look into local architect's design intention, cultural identity meaning and expression, to determine which symbols, cultural aspects, architectural elements and sources of inspiration informed their sustainable designs and how these might inform the development of new LEED indicators or revisions to existing credits.

Perceived spaces, may be linked to local school building use (programming) and include circulation and transition spaces, among other areas for social interaction and community building, which contribute to the community's Quality of Life. Jeffres et al. (2009) identifies *third places*, including schools as:

- Neutral: all are welcome
- Leveller: people of different social strata attend
- Conversation as main activity and other activities
- Accessible
- Home away from home
- Playful mood

He argues that these places foster community and communication among people outside home and work; the first and second places of daily life. He also identifies areas on the community nearby, as well as places within the school that might foster social interaction, including but not limited to:

- Community centres
- Recreation centres
- Libraries
- Outdoor recreation spaces

Socio-cultural spaces have varied depending on the government and Department of Education priorities at the time schools were built. The teaching of vocational studies, arts, sciences and technology, among other disciplines have also impacted the school program and hierarchy of spaces. For example, the Schools for the 21st century project gave importance to sports infrastructure, library as technology centre, science/art laboratories and community integration by providing shared spaces (Fielding Nair International, 2010: 25-26, 30). We will analyse these spaces to identify which architectural and Placemaking strategies were employed by local professionals to promote school-community relations, as well as sense of pride and ownership amongst its members.

Lastly, **lived spaces** focus on how human beings use the space and modify it for their own use. In this sense, this may apply to both the school user but also to professionals', who are users of the LEED infrastructure. This research will particularly investigate user satisfaction and professional's experience with the system during the design and construction process of case study schools. Also, the adaptations performed to the system in order to apply it to the local context, as will be further explained on Chapter 5.

As indicated on Figure 3-5, this research will primarily analyse the space "conceived" by the design team, focusing on design intention, user perception and building use and how it is culturally translated into design. This will inform the research methodology which includes a survey or cultural identity profile and interviews to design and construction professionals (architects, engineers and sustainability consultants) of case study schools.

Initially, this research also included a survey and interviews to school directors. Unfortunate events, that included a 6.4 magnitude earthquake on January 2020, as well as the Coronavirus (COVID-19) pandemic, made it impossible to obtain the required permits and administer the survey within the established timeframe. However, a draft of the research instrument is included in the PhD thesis Appendix C as reference. Further research may compare user perception and space use informed by directors, with the design intention and cultural expression indicated by professionals.

3.7. Summary

This chapter presents the main theorists and theories that informed the theoretical background and the conceptual framework diagram. As indicated in Figure 3-6, we established the research position and role of culture in sustainable development referencing the sustainability square (Ebert 2011:21, Mateus and Bragança 2011:1962), as well as Soini and Dessein (2016:4) conceptual framework model. Also, we analysed the LEED Impact Category (IC) and Point Allocation Process

Document (Owens et al., 2013) to identify LEED’s culture-related components and measures, that could be developed as indicators.

Theoretical Framework: Main Authors Referenced

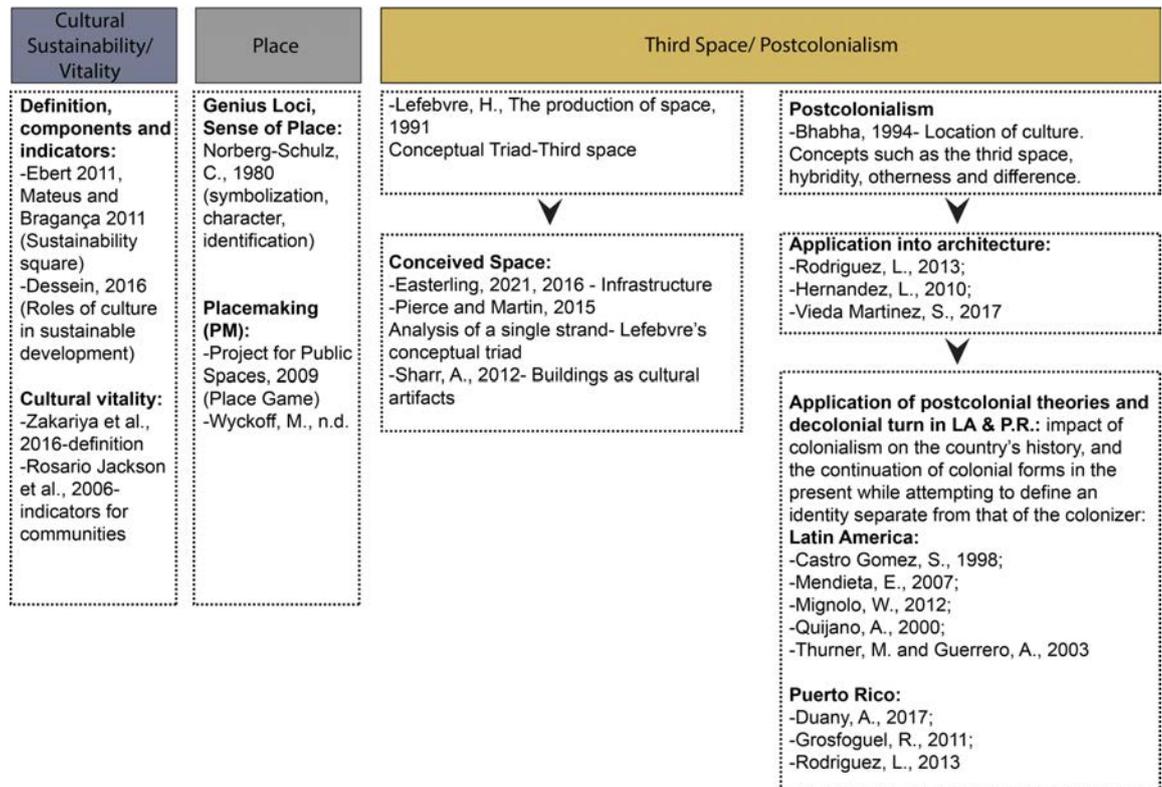


Figure 3-6: Theoretical framework: Main authors referenced in this research. Diagram summarizes the main theorists and theories discussed in this chapter that informed the theoretical background and the conceptual framework diagram.

The literature review identified cultural vitality and its components by referencing Zakariya et al.’s (2016) definition of the concept and Rosario Jackson et al.’s (2006) indicators for communities, which may also be applicable for the school context. Placemaking, as well as, cultural identity and expression were also identified as key components for strengthening the cultural sustainability dimension in LEED.

Norberg Schulz phenomenological standpoint helped understand how places are shaped and their symbolical meaning, which has evolved into the emerging concept of Placemaking as discussed by the Project for Public Spaces (2009) and Wyckoff (nd.). Recent authors that have built upon Schulz phenomenological theories (Pallasmaa, 2012, Pérez-Gómez, 2015) will be discussed on Chapters 5 and 7, to

justify the methodological strategy employed in this research, proving the current relevance of his theories.

This literature review also aimed to determine (1) if postcolonial theories be applied to the Island to understand its social, cultural, environmental and economic context and analyse relevant concepts for P.R.; (2) how architecture was used as a vehicle to transmit and build a national cultural identity in P.R.; and (3) how P.R.'s hybrid culture is expressed in its architecture. Throughout this chapter it was demonstrated how South Asian postcolonial concepts were culturally translated for the Latin American and Caribbean context. Furthermore, demonstrated that postcolonial theories can be applied to P.R. Throughout this chapter, three main concepts were analysed, as they apply to the Island: cultural identity and nation building through discourse; hybridity and the third space. Homi K. Bhabha's postulates were employed in the discussion of these concepts, complemented by recent literature from Hernandez (2010), Rodriguez (2013), and Vieda Martinez (2017) that have built upon his concepts and applied his theories into architecture. Furthermore, Latin American and Puerto Rican authors have employed, transformed, critiqued or built upon postcolonial theories to discuss the impact of colonialism and the continuation of colonial forms in the present while attempting to define an identity separate from that of the colonizer.

In P.R., architecture has been used as vehicle to transmit a message of progress, civility and tropicality, as can be evidenced through P.R.'s public schools. Their design combines foreign architectural styles and elements from Europe and the U.S. that were adapted to the local context in order to define a hybrid architectural identity for the Commonwealth Island.

This analysis sheds light into the relationship between P.R.'s culture and its architecture, in order to determine what cultural aspects of sustainability in the tropical Caribbean region are excluded from LEED but could be incorporated (R03). Based on the analysis of postcolonial theories, this research suggests that there should be a recognition of the following aspects in LEED:

- Need for cultural adaptation of its categories and credits
- Recognition of cultural identity, which in the case of P.R. is framed by hybridity due to its colonial background
- Recognition of architecture and schools as third spaces, where social interaction occurs, and users can contribute or hinder the achievement of sustainability goals

This chapter also included the development of the conceptual framework based on Lefebvre's Conceptual Triad as it applies to sustainability in P.R. His work informed the third space concept definition and application into the "abstract space". Following Pierce and Martin (2015), who recognize that all strands of Lefebvre's conceptual triad are interconnected but may be studied separately, this research will analyse the space "conceived" by the design team, focusing on design intention, user perception and building use and how it is culturally translated into design. To further analyse the conceived space, contemporary authors such as Easterling (2021, 2016) were employed to make a link between the mandatory imposition of the LEED "infrastructure" in federally funded school projects in the Island.

The next chapter will explore P.R.'s hybrid cultural identity through school architecture and provide a historical background to demonstrate how societal, economic and environmental changes have shaped its citizens and the built environment.

Chapter 4: : [Re] defining P.R. Cultural Identity

4.1. Introduction

Puerto Rico has been subject to a myriad of cultural influences due to its colonial background (Indigenous, African, Spanish, and American, among others). Since P.R. is no longer labelled as a colony by the United Nations, but as a Commonwealth of the U.S., postcolonial theories, such as those promulgated by Homi K. Bhabha (1994), can be referenced to explain how cultural influences were transformed from an identity of “otherness” into *Puertoricanness*.

It can be argued that P.R. has a hybrid culture that has been affected throughout history by social, environmental, and economic events that have formed or re-defined it, and vice versa. This research identifies the people (Puerto Ricans) and a particular architecture style (Tropical Architecture) as the epitome of hybridity in the Island, and as necessary background to contextualize sustainable architecture in schools. The understanding of the building user profile and place will allow for the development of LEED indicators specific for the P.R. context.

Section 4.2 will discuss four (4) main events or turning points, which have brought about changes to school architecture, namely, the Spanish colonization (1493), American invasion (1898), Industrialization (1947) and Commonwealth (1952). Architectural designs during these periods will be discussed in order to contextualize the Schools for the 21st Century project analysed on this research. Lastly, section 4.3 will summarize the chapter findings and present conclusions.

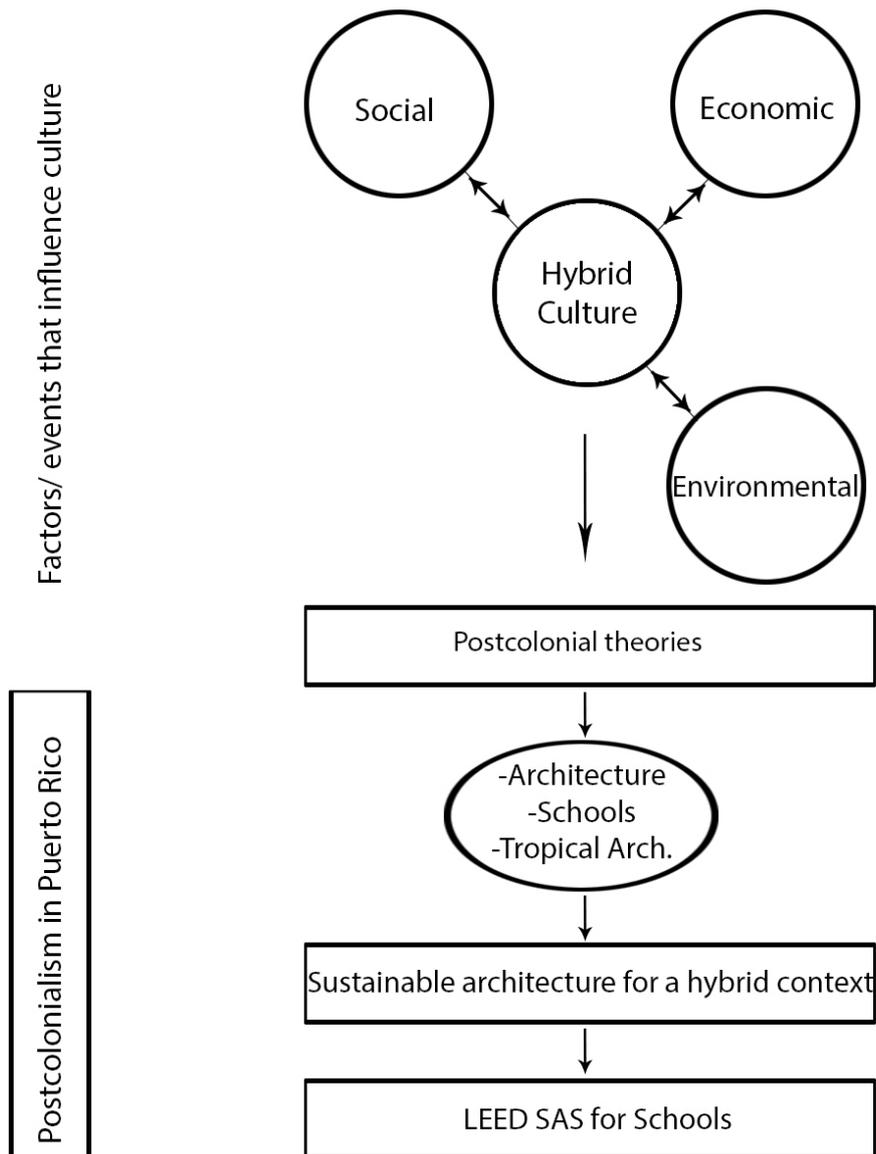


Figure 4-1: Conceptual diagram by author, inspired by Culture for Sustainable Development (Dessein et al., 2015b:29)

4.2. P.R. in Context: Forming a Cultural Regional Profile

This section will focus on the Puerto Rican hybrid culture and how societal, economic and environmental changes through history have shaped citizens today and how these changes have impacted school architecture. Figure 4-1, presents a reinterpretation of the Culture for Sustainable Development model (Dessein et al., 2015b:29) presented in Chapter 3, as it applies to the P.R. context. In this diagram, culture is portrayed as mediator between the other sustainability dimensions. The

next sections will discuss school architecture through a Postcolonial lens, recognizing external influences that have shaped local designs throughout history. It is of particular interest for this research how tropical architecture concepts influenced sustainable design practices in case study schools. This information will serve as background to propose new LEED credits and revise existing ones, taking into consideration the local context.

This chapter also presents a contextual background for this study, organized through mayor events in Puerto Rico's historical development that have shaped or [re]defined its **cultural identity**. According to Hawkes (2001:31), "identities are fundamentally forged, tested and developed through visceral human interaction". It is in places, whether natural or man-made, that these interactions occur, and identities are shaped. Therefore, this historical interpretation is defined by turning points such as the Spanish Colonization in 1493; the American Invasion in 1898; Industrialization and Operation Bootstrap in 1947 and the establishment of the P.R. Commonwealth in 1952. These turning points were chosen based on their impact on local cultural identity and architectural design.

Event 1: Colonization (1493)

Taino Indians - Africans - Spaniards

Located in the Caribbean²⁴, the Island *Boriken* or *Borinquen* (Land of great lords), was originally inhabited by the Taino Indians, a subgroup of the Arawakan Indians from South America, who were also settlers in the rest of the Greater Antilles (Cuba, Jamaica, Haiti, and Dominican Republic). To establish ownership, the Island was renamed by the Spaniards as Puerto Rico or *Rich Port* for its abundance of natural resources and its central location for trade and military defence.

The arrival of Christopher Columbus to the Island in 1493 marks the beginning of the Spanish settlement and colonization period. Also, the start of histories of exploitation

²⁴ P.R. is located between the Caribbean Sea and the North Atlantic Ocean and is the smallest of the Greater Antilles.

and *mestizaje* (mixing of cultures and/or races) shared with the neighbouring islands (McGoldrick et al., 2005: 242). The Spaniard's imposed their native language, dress code, literature, food preferences, catholic religion, and political structure on the Indigenous population but also on the African slaves brought to the Island as hard labour (McGoldrick et al., 2005: 242). This led to a process of negotiation, sometimes peaceful but others violent, which led to the development of a *hybrid* culture as generations passed.

P.R.'s culture includes traits from both the Taino and African population that are evident in everyday life and language, such as musical instruments, superstitions, legends, food, and words integrated into the Spanish language. Puerto Ricans inherited from the Indigenous side, great love for the land, a tranquil and peaceable conduct, kinship, and group dependence, but also the strength and resilience of the African enslaved race. From the Spaniards, P.R. adopted the Spanish strong family ties, traditional family life and male-dominated family structure. Mixed racial manifestations, including face complexion, skin colour and physical traits, are common throughout the population (Abbad y Lasierra, 1866: 41, 338, 400; McGoldrick et al., 2005: 243).

The Island became Spain's military outpost in the Caribbean from the 16th until the 19th century, when independence movements on the Island began to reclaim its freedom from Spain's authoritarian regime, while others reclaimed full assimilation. After four centuries of Spanish dominion, its Prime Minister granted P.R. the right to self-government, constitution, and a monetary system, with the Charter of Autonomy (1897), among other measures, to avoid a separatist revolution such as the one in nearby Spanish colonies like Cuba. However, Puerto Ricans right to self-government only lasted a year because the Island was invaded during the Spanish-American War of 1898 (Trias-Monge, 1997:11).

When the Americans arrived at the Island, they came to a rural society,²⁵ where agriculture was the main source of employment and food. The “*jíbaro*”, a noble, hardworking “country man”, barefoot, with his arched back for working on the land, machete in hand and hat for sun protection is still a symbol of the love for the land and is still reminiscent of this period in P.R.’s history. The *jíbaro*, an epitome of hybridity and colonial identity at this time, was product of the Indigenous, African, and Spanish influences in the Island up to that date. Representing the poor and working segments of the nascent society, this image highly contrasted with the wealthy (*hacendados*, landowners, merchants) and the educated segments of the population (Habell-Pallan, 2002: 48–50; Laguerre and Melón, 1968: 19).

Education was mostly religious, carried out in convents and churches until the second half of the 19th century when few schoolhouses²⁶ were proposed and built (Parsons, 1976: 13; Rodriguez, 1979: 15). These included single gender-classrooms, patio, vestibule, library and a separate room for the teacher and their family due to the limited road network at the time. The classroom layout emphasized on the teacher as the authority figure by including a teacher’s desk and long narrow tables to accommodate the largest number of students and facilitate their supervision Figure 4-2. Also, rooms were required to display images of local illustrious men but also disseminate Spanish beliefs through iconography by including an image of Jesus Christ and the King of Spain (Lopez Borrero, 2005: 39, 43, 45).

²⁵ Main crops cultivated in the Island included coffee, followed by sugar and tobacco. The following year the coffee production was affected by hurricane *San Ciriaco* (1899).

²⁶ The 1865 *Organic Decree* established the need for *schoolhouses* and the *Public-School Regulations for Elementary Primary Instructions* (1865) established the school structure and classroom layout (Lopez Borrero, 2005: 39).

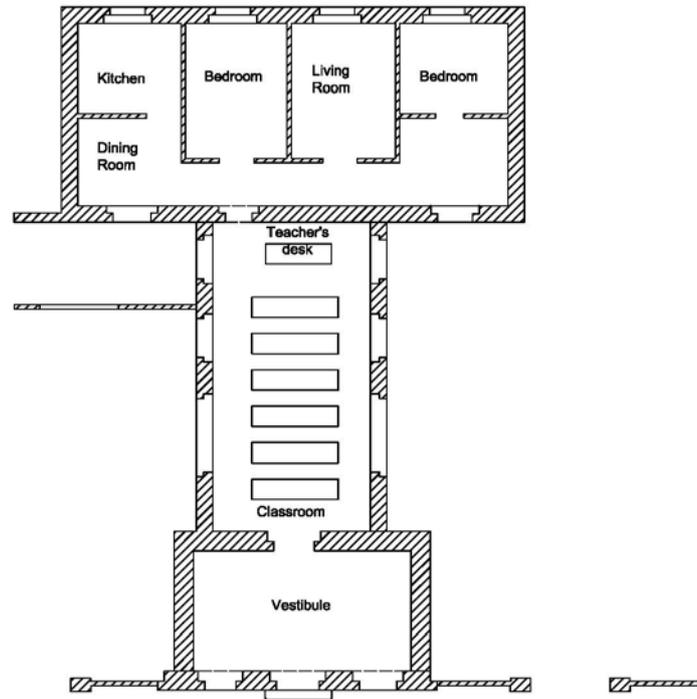


Figure 4-2: Plans for a schoolhouse in Puerto Rico (1888) and a classroom furniture layout depicting long narrow tables for students, facing the teacher's desk (Diagram based on plans in: Lopez Borrero, 2005: 50, 176).

Even though public school requirements were in place, an inspection commissioned by the local governor in 1878 revealed that many schoolhouses, particularly those in rural towns, did not meet the required size, location and hygienic conditions (Lopez Borrero, 2005; Osuna, 1934: 79). To improve these conditions, a proposal to advance the erection of “school building projects” (1888) with government funding proposed brick masonry units following the distribution, dimensions and decorations proposed by Madrid’s School of Architecture, adapted to the local economic conditions, climate, and other circumstances (Macho-Moreno, 1998: 387–389). Both educational models and architectural designs followed imported European standards. An example is shown in the Spanish colonial school façade in Figure 4-3.

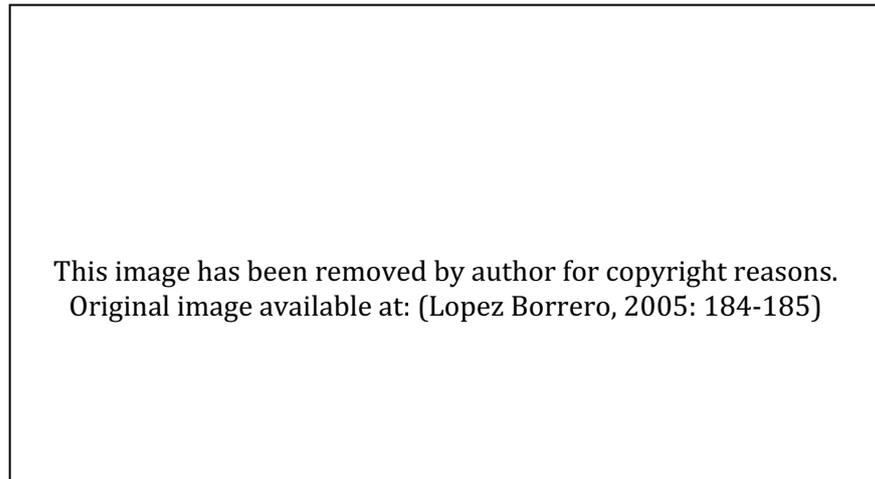


Figure 4-3: School for the Marine façade (1890) (Source: Lopez Borrero, 2005: 184-185).

While education had not been a priority for the Spanish regime, it will be recognized by Americans as an important vehicle for spreading knowledge, political and social ideals (Rigau, 1992: 144). While only just over 500 schoolrooms were inherited from Spain, this number would increase significantly during the early years of American dominion²⁷.

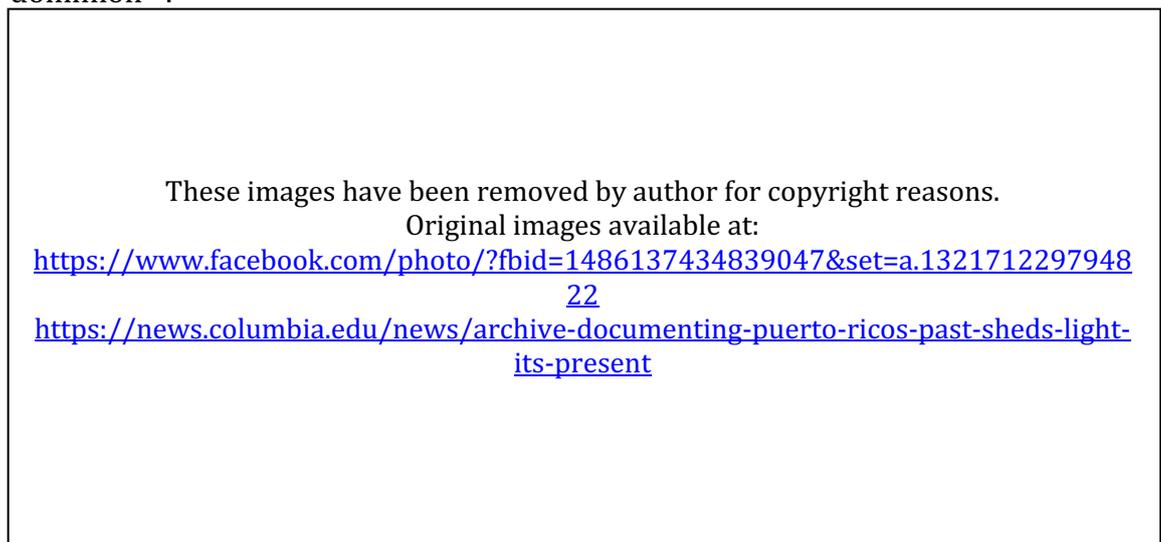


Figure 4-4: Public schools in Puerto Rico. Left: Spanish regime rural school (Source: <https://www.facebook.com/photo/?fbid=1486137434839047&set=a.132171229794822>), Right: Girl with American flag (1946), Delano Collection, Rare Book and Manuscript Library, University of Columbia (Source: <https://news.columbia.edu/news/archive-documenting-puerto-ricos-past-sheds-light-its-present>)

²⁷ When William Hunt took office as P.R. governor during year 1900, the illiteracy rate was 79.6%. 3,273 schoolhouses were built by 1930 to fulfil the urgent need for education and a population increase (Rigau, 1992: 144).

Event 2: Invasion (1898)

Spaniards - Americans

Since 1898, the U.S. invasion during the Spanish-American War, P.R. has been influenced by the American culture. By signing the Peace Treaty of Paris, Spain ceded P.R., Guam, and the Philippines to the U.S. The Foraker Act of the 1900, defined an ambiguous relationship between countries stating: "Puerto Rico belongs to the United States, but it is not the United States, nor a part of the United States."²⁸ The imposition of U.S. values as superior, was also accompanied by the adoption of the sugar cane industry as main economic activity, American currency, citizenship, economic policies, and governmental structure.

There was an intention that P.R. assimilated the American culture, from the English language, dress code and food, adding yet another layer to the cultural mix. As part of the colonization process, the Colonizer imposes its culture on the Colonized and, identities are shaped by the image of the "other" (Fanon, 1967: xiv). This leads to *colonial mimicry* or imitation of the colonizer's culture. Bhabha defines the concept as the "production of an image of identification and the transformation of the subject" (1994: 122,64). *Colonial mimicry* was also evident in the application of imported architectural styles that were used to build the first American schools. Prominent educational buildings included the Rafael M. Labra School (1916), a red brick clad building known for its Georgian Style architecture and the Central High School (1925), a U-shaped Neoclassical building, set-back from the main avenue, its importance underlined by a stepped promenade and a heavily decorated portico (Figure 4-5). Many of the early 20th century schools were built facing important streets or located adjacent to the town's main plaza making its presence comparable to the church and city hall as the third most important building in towns. Its

²⁸ Congressional Record, 56th Congress, 1st session, April 30, 1900, p.4855. The P.R. government was also established in the 1900 with the Foraker Act, but its governor and executive council were appointed by the U.S. President. The elimination of the 500 Acre Law, that limited the amount of land individuals could own, forced many small land owners to go bankrupt or sell their land to big companies. This promoted the U.S. sugarcane industries as monoculture.

monumental scale, object quality and/or architecture style contrasted with its immediate context (Rigau, 1992: 144).

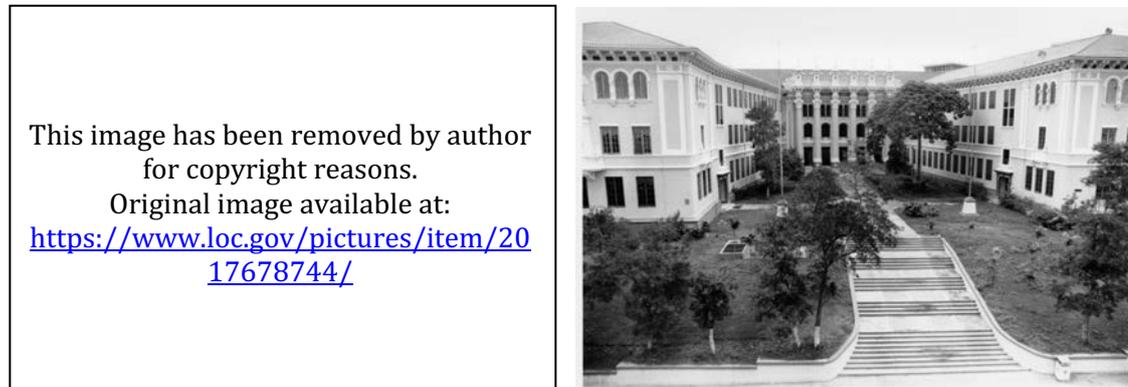


Figure 4-5: Left: Rafael M. Labra School, Right: Central High School in San Juan, P.R.
Sources: (Library of Congress, 1919; Rigau, 1987)

American architects and engineers brought the experience of new materials, such as steel, concrete, cement blocks, construction technology, machinery, building systems, and project coordination.²⁹ After the Great Depression and World War II, work was carried out by local architects, that were U.S. school graduates (Rigau, 1992: 147). These, as well, were influenced by current international styles at that time such as the Spanish Revival, Art Deco and Pre-modern.

Post 1898 schools were built island-wide to spread U.S. values and culture throughout the new acquired territory. Schools were considered by some as an instrument to “Americanize” the masses, civilize the country and expand the local government’s reach and authority to rural areas (Del Moral, 2013: 8). According to Aida Negrón de Montilla, these were an instrument for cultural assimilation meant to displace the native culture (1998:7). However, cultural resistance movements with strong hispanophilic values soon emerged (Sambolín, 2015:15), including pro-independence movements but also the definition of a Puerto Rican identity within the American dominion, as will be further explained on the next event.

²⁹ The Office of Public Buildings (1907) was created by the U.S. Department of Interior to oversee the construction of public buildings in P.R., including schools.

Event 3: Industrialization and Operation Bootstrap (1947)

Americans - Puerto Ricans

Modelled after the U.S. industrial revolution (1870-1916) and the New Deal³⁰, Operation Bootstrap was the economic model established in 1947 to modernize and transform the Island into an industrial and developed one. Reform was necessary after the Great Depression (1930's) and World War II (1940's), where the U.S. sugar monoculture industry had led to poverty, mass migrations, unemployment, and an unbalanced economic structure due to a crash on sugar prices that affected P.R. and the Caribbean (Ayala and Bernabe, 2007: 96, 180).

Industrialization was the development strategy implemented under Luis Muñoz Marín's incumbency (1948-1964), P.R.'s first democratically elected governor under the Popular Democratic Party (PDP), to create jobs, and improve citizen's economic conditions. Operation Bootstrap relied on foreign investment and provided tax exemptions to American corporations that established in P.R., who would also benefit from lower labour costs. The strategy, dependent on foreign capital, technology and enterprises, integrated P.R.'s economy to that of mainland U.S. (Skidmore et al., 2013). Soon manufacturing and tourism became the main economic motors for this U.S. "tropical paradise", in addition to the establishment of American industries and multinational companies (Skidmore et al., 2013). However, rapid economic growth influenced other social and cultural changes in the Island.

The Muñoz administration used culture as a government tool to generate policies and institutions that would differentiate the Island's culture from the American one while safeguarding and promoting its patrimony and heritage.³¹ This "cultural

³⁰ The New Deal, promoted by U.S. President Franklin D. Roosevelt during the 1930's, included a series of programs to help recover the country from the Great Depression.

³¹ One of those institutions was the "Instituto de Cultura Puertorriqueña" or Institute of Puerto Rican Culture, created under Act 89 of June 21, 1955 "to study and preserve our cultural-historic heritage and to stimulate, foster, promote and divulge the various manifestations of Puerto Rican culture" (ICP, 2011). The government also promoted artistic development through the construction of music conservatories, art schools, among others.

nationalism” helped to strengthen the individual and collective sense of belonging of a nation associated to another, by defining Puerto Rican symbols, myths, memoirs, rites, flag, among others (Duany, 2003: 436). With this initiative, the government also aspired to bring cohesiveness to a country in transition from an agrarian to industrialized society.³²

In 16 years, the Muñoz administration transformed the island’s economic infrastructure and marked the beginning of P.R.’s modern era. The industrialization and economic prosperity achieved by Operation Bootstrap, marked the development of a collective identity, and the notion of *Puertoricanness*. Bhabha uses the concept of ***cultural translation*** as metaphor to explain how the existing culture is translated or transformed it into a hybrid, multicultural one. He states:

The “social articulation of difference, from the minority perspective is a complex, on-going negotiation that seeks to authorize cultural hybridities that emerge in moments of historical transformation” (Bhabha, 1994: 3).

In the case of P.R., this cultural translation was performed by the Design Council, founded in 1943³³, composed of international architects such as Richard Neutra (Austrian) and Henry Klumb (German) that were responsible for the design of school buildings and defining what later would be known as “tropical architecture”.³⁴ This ornament free architectural style is characterized by an open floor plan, wide corridors and indoor patios that foster interaction, strong connection with nature,

Other cultural institutions such as museums, libraries and national archives were also established.

³² Puerto Rico's economy was dominated by sugar production until the 1940s (Dietz, 1987). Currently, manufacturing comprises about 47.6% of the gross domestic product (GDP) of the island, followed by the Finance, insurance and real estate (19.7%) and the service industry that includes tourism (Government Development Bank for Puerto Rico, Economic Analysis Division, 2016).

³³ Rexford Tugwell appointed as P.R. Governor by U.S. President F.D. Roosevelt (1941-46). Klumb was in charge of the Design Division, and then founded his private office in P.R.

³⁴ After the development of the University of Puerto Rico’s School of Architecture in 1966, architects were trained locally by a faculty formerly trained in U.S. schools and abroad, influenced by international ideas. Today, there are a total of four architecture programs in the Island.

modularity, *brise soleils*, and deep awnings, among other passive design strategies, as explained in Chapter 3.

A school model prototype was developed for rural areas that were most in need and housed more than two thirds of the population (Rodriguez, 1979: 18). The first rural school built using Neutra's design was the Sabana Llana School in San Juan (1944), with design features similar to the Emerson and Corona Avenue Schools in California by the same architect, shown in Figure 4-6. Locally, the school design benefited from the local climate to generate material and economic savings. Its pivot doors could be opened completely to provide shade, allow for a stronger visual connection to the outdoors or deliver indoor/ outdoor lectures. This outdoor room extension doubled the usable space and allowed for a smaller classroom serving a larger number of students (Figure 4-7). Furthermore, the outdoors allowed students to experience the "richness of life teaching objects" (Neutra, 1948: 51), an idea that today can be identified with place-based education which employs local heritage, landscapes, culture and experiences across the curriculum (Ormond, 2013: 19).

Neutra's school model was later modified because the wooden pivot doors warped when there was a rise in humidity or in damp conditions and the high ceilings let the rain in (Rodriguez, 1979: 20). Furthermore, the rural area in which the school was located, later became urbanized and its pivot doors, were replaced with concrete blocks and aluminium windows for security reasons, limiting its flexibility and natural ventilation. As shown in Figure 4-7, a public road was built on the back and the patio, which was designed as an extension of the classroom, was closed off with a chain link fence.

The passive design strategies employed by this school in the 1940's are still relevant nowadays: the concrete structure had a sloping roof structure with inverted beams, to maximize the entrance of natural lighting and ventilation, while also facilitating rainwater collection. Also, the school design included early exploration with standardization and modularity to facilitate its construction throughout the Island. Likewise, the rural school was designed as a community centre and a social nucleus.

The complex included the health centre, milk dispensary, a farm and the teacher's residence, in order to fulfil resident's needs considering there was a limited communications network at the time. The architect also envisioned that the school may be used for adult activities after school hours, and his design even included a paved outdoor dancefloor to add a social attraction to this "center of cultural and civic promotion" (Neutra, 1948: 52). According to Neutra, the community should take ownership of the school:

Only thus, through the psychological taking possession of the institution by the entire community, does it become appreciated communal property instead of just appearing to be the scheme of a far distant government engaged in a showy drive against illiteracy (1948: 44).

Even though the rural prototype designed by Neutra was later modified by Klumb for urban areas, the construction of this model school marks the beginning of a series of exploration of design alternatives to define the Puerto Rican school, through the construction of building prototypes that fulfilled the basic educational needs of the population and could be reproduced rapidly and economically (Rodriguez, 1979: 20).

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Original images available at: <https://neutra.org>

Figure 4-6: Richard Neutra school designs. Left: Emerson School drawing by Richard Neutra (1938). Right: Corona Avenue School, California (1935) by architect Richard Neutra. (Source: <https://neutra.org>).

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Original image available at:
<https://neutra.org/project/puerto-rico-rural-health-centers-classrooms-and-hospitals/>



Figure 4-7: Sabana Llana School in San Juan, P.R. by Richard Neutra (1944 vs. today). Left: Recently inaugurated school (Source: <https://neutra.org/project/puerto-rico-rural-health-centers-classrooms-and-hospitals/>). Right: School renamed as Gerardo Sellés Solá School. The pivot door on the back was closed with concrete blocks and aluminium windows. A public road was built on the back and the patio was closed off with a chain link fence. The school was closed, under the administration of former DEPR secretary Julia B. Keleher (Image source: Google Earth, 2022).

During the 1950's, industrialization forced people to move from the rural areas to the urban centres. As response, a second group of schools was built to fulfil the increasing demand for this public service, once again using a prototype to facilitate its construction (Rodriguez, 1979: 21). The two (2) floor structure was characterised by single loaded open corridors connecting side by side classrooms, while stairs and restrooms were strategically located in the corner to allow for the construction of perpendicular building wings. The *República de Colombia* school in San Juan by Pedro Amador (1946) is an example of this model, which followed passive design practices including adequate building orientation to maximize cross ventilation and the provision of wide awnings for sun protection (Galarza, 2004:10) (Figure 4-8).

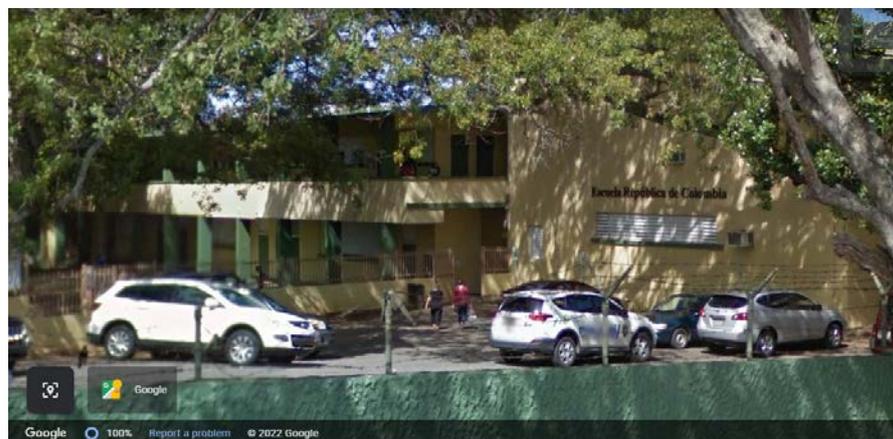


Figure 4-8: *República de Colombia* school in San Juan by Pedro Amador (1946) (Source: Google Earth, 2022).

Event 4: Commonwealth (1952)

At this time, Puerto Rican's political opinion was divided between those that reclaimed P.R.'s identity separate from the U.S. and those in agreement with the current relationship between the two countries. After the 1950's nationalist revolts, a Referendum was held on March 3rd, 1952 to decide on P.R.'s political status (Duany, 2017a: 56). This event was an affirmation of the new Constitution of the Island as *Estado Libre Asociado* or Commonwealth with 81.9% of votes in favour (Malavet, 2004: 72). However, Puerto Rican nationalists question the meaning of the referendum, since there were only two choices available, namely existing colony or "commonwealth". Neither independence or statehood were on the ballot.

On July 25th 1952 after ratification by the U.S. Congress and President, Governor Muñoz Marín proclaimed the constitution was ratified, defining the Island's local government structure and bill of rights, in accordance with the U.S. Constitution (Méndez and Fernández, 2015: 253). It was not a coincidence that this date was chosen, as it had the intention to replace the 1898 commemoration of the U.S. Invasion.

The Commonwealth status allowed for political, environmental, social, cultural and economic autonomy in local matters, including: governmental elections, law creation, taxation, economic development, education, health, housing, culture and language. However, the U.S. federal government would remain in control of state affairs such as: citizenship, immigration, defence, currency, transportation, foreign trade and diplomacy, among others. Previously approved legislation that granted U.S. citizenship, welfare benefits and access to federal funding remained (Duany, 2017:74).

P.R.'s ambiguous political situation is still highly debated today, and its colonial status is not evident worldwide. After the creation of the United Nations (UN), the colonial status was considered a crime and menace to world peace (Sambolín, 2015:16). The year after the creation of the Commonwealth of P.R. or Free-Associated State, the Island was removed from UN's list of "non-self-governing

territories”, creating a condition of “postcoloniality”. Originally, the Commonwealth was supposed to be transitory status, “in between” statehood and independence, as it does not alter P.R.’s legal, political and economic dependence on the mainland (Duany, 2017:75).

The establishment of the Commonwealth generated different political viewpoints amongst the population regarding the Island’s relationship with the U.S. The discourse of local political parties varies between those that promote full annexation to the U.S., status quo or independence. Power has predominantly been held alternately by the New Progressive Party representatives and the Popular Democratic party, defending the first two options, respectively. This political overturn has affected and changed the school’s curricular and architectural design vision during the 20th century, as will be discussed in this section.

Industrialization in the Commonwealth continued during the 1960s and 70s, the population increase in urban centres required the rapid construction of new schools and replacement of existing wooden structures. Simpler and more economical prototype designs by Russel E. Latimer and architect Vázquez Valedón maintained the previous layout of single loaded open corridors connecting side by side classrooms (Figure 4-9). However, to reduce construction costs, functionality was prioritized over aesthetics resulting in a simple concrete building with aluminium windows, limited recreation areas, smaller classrooms and a reduced number of awnings with limited protection against the rain (Galarza, 2004: 11).



Figure 4-9: 1960s P.R. school prototypes. Left: Design by Russell Látimer (used from 1960s-80s). Right: Typical classroom module by architect Vázquez Valedón (1961). Both show single loaded open corridors connecting side by side classrooms (source: Galarza, 2004: 11, 13).

A study of existing schools presented by the architect Jesús Amaral (1973) revealed that poor aesthetics and a weak sense of belonging resulted in inadequate maintenance of buildings and vandalism, a problem still present in many schools today. Therefore, he presented a new hybrid design alternative by combining an imported modular steel construction system from the U.S. with aluminium windows that were built locally (Amaral, 1973; Galarza, 2004: 30).

The University Gardens school in San Juan was designed with double loaded corridors to create a more compact structure than previous prototype schools with single loaded hallways. This model school included air conditioning systems for better acoustics, and reduced air contamination, even though its operable windows could be opened if the equipment was damaged. However, other schools built under this program were naturally ventilated considering the tropical climate but mainly for economic reasons, due to the long-term electricity costs (Galarza, 2004: 34).



Figure 4-10: University Gardens school in San Juan by architect Amaral. Left: Architectural model, Right: School library included modular systems furniture and building systems (Source: Colección Amaral y Morales; Archivo de Arquitectura y Construcción, University of Puerto Rico).

One of the most important contributions was its open classroom layout that allowed for the implementation of new teaching techniques and a variety of furniture configurations. However, the model was critiqued due to its interior flexibility which caused acoustic problems and lack of privacy but also due to material deterioration. Only nine schools were built and the model was discarded by the Public Buildings Authority (PBA), the governmental corporation in charge of overseeing school design

and construction, who returned to the previous school prototype disregarding its problems (Galarza, 2004: 14, Rodriguez, 1979: 31).

However, Amaral's design presented ideas that were later employed in the Schools for the 21st Century project (2010) and are still relevant today. Strategies included, but were not limited to, the implementation of a modular system to reduce construction lead time and the independence of the building envelope from the structural system which allows for future changes on the façade, as done in case study school A. Also, several concepts were included in this research proposed LEED credits (Chapter 8), such as the design of spaces with a flexible layout and furniture in the *Learning environments and school culture foster creativity and innovation* (31.11) indicator. Furthermore, the flexibility to configure interior building systems by including a flexible ceiling track that allows for the configuration of lights and air conditioning grills was also included as a strategy to promote design for adaptability in the *Building Life-Cycle Impact Reduction* (29.3) indicator.

During the 1970s and 80s, there were minimal modifications to the Public Building's Authority floorplan used as reference for school designs, however, improvements such as the inclusion of recreational facilities, larger communal spaces such as the school canteen and library, landscaping and better materials brought positive results. The previous configuration of standalone classroom buildings created unused areas that led to security problems and diffculted student supervision, however, several architects re-organized the typical school prototype defining an interior patio, an idea previously seen in Spanish institutional buildings and early American 20th century schools. This organization allows clear sight lines within hallways and common areas, reducing hiding places, and allowing teachers and staff to easily observe students. These schools were better maintained than other previous prototypes, which suggests user sense of belonging (Galarza, 2004:15). The patio as an organizational element was a strategy employed in the Ramón de Jesús Sierra School (1978) in Lares, P.R. by architect Segundo Cardona (Figure 4-11) and designers on case study 21st Century schools. Also, in both projects, administrative areas were located near the entrance to facilitate visual and access control.



Figure 4-11: Ramón de Jesús Sierra School (1978) in Lares, P.R. (Source: Google Earth, 2022).

A restructuring of the DEPR and the public-school concept³⁵ took place in the 1990s, and included the development of community schools, to promote the involvement of parents, students, teachers and supporting personnel in academic, operations and maintenance aspects. This initiative gave more autonomy to schools in teaching, administrative and fiscal matters (Torres González et al., 2017: 134). A study performed to 40 of the initial community schools, highlighted the reduction of student absenteeism and vandalic acts (Junta de Planificación de Puerto Rico, 2003: 50). However, this law faced opposition by the teachers, who criticized its implementation process. Even though the concept of “community schools” was later discarded, it led to the publication of a series of circular letters by the DEPR that further defined and attuned the school/ community relationship (Junta de Planificación de Puerto Rico, 2003: 348).

While previous efforts had been based on the development of a school prototype and plans that allowed for the mass construction of school buildings, this time, a guide or manual titled *School Boom 2000* for the development of turn of the century schools was created by local architect Pablo Figueroa (DEPR, 1998). Being a project under

³⁵ Several laws contributed to the redefinition of the PR Department of Education and the public school system, including: Law 68- 28 August 1990, Organic Law PR Department of Education, and Law 18, 16 June 1993 for the development of Community Schools.

the New Progressive Party administration, schools were meant to equate those in the U.S. Guides from several states were used as reference to develop guidelines adapted for the Island (Galarza, 2004: 54). This guide gave more freedom to the designer and allowed for each school to have its particular identity. Buildings were designed in a larger scale and with aesthetical considerations, giving diversity to the typical module. One of the 198 schools targeted by this program was the *Escuela Superior Vocacional Artesanal de la Montaña* (1999) in the municipality of *Barranquitas*, designed by architect Figueroa (Galarza, 2004; Gonzalez-Calderon, 2006: 17358). The building has a prefabricated steel structure independent from its envelope, a concept previously implemented by architect Amaral in the 1970s. However, the school's building envelope was enclosed and airconditioned with double loaded corridors, and depended on artificial lighting, far from the passive design and tropicality concepts from the 1950s.

The global decline of passive design during the second half of the twentieth century, impacted the building design and construction industry, including codes, standards and eventually building certification systems such as LEED. The availability of HVAC equipment and modern control technologies became the preferred choice for ventilation. Building's orientation, mass and natural ventilation were seen more as a restriction in an industry driven by cost, schedule, and efficiency. HVAC systems were understood to provide more temperature, humidity and airflow control than natural ventilation. However, measures to procure energy efficiency during the oil crisis context (1975) and beyond oftentimes resulted in lower indoor air quality for the occupants, while increasing the amount of bacteria and airborne contaminants (DNV, n.d.).

However, even though the next school projects in the Island, namely, the New School, and the Schools for the 21st century, used the *School Boom* guides (DEPR, 1998) as reference, school buildings will reflect the renewed interest for passive design strategies considering its benefits in the reduction of energy consumption and user well-being. These revised guides included specific school facilities layouts and plans considering the user and equipment, particularly those required for the

teaching of specific trades in vocational schools. Paint colours and materials were specified in the guides to create uniformity within the schools, a concept carried out in the Schools for the 21st Century project as well.

With the change of political administration, a new vision for local schools designs was carried forward by the Popular Democratic Party (Gonzalez-Calderon, 2006:17358).

A report by the P.R. Senate, stated that political changes affected this project:

Information has come to the attention of this Senate of Puerto Rico about obstacles experienced by [...] the "School Boom 2000" program, whose construction has been stopped and/or has been redesigned due to an alleged change in educational public policy. These abrupt changes have been made despite the fact that the schools were designed, auctioned and awarded, in addition to having set aside the corresponding funds for their construction. The situation described reaches alarming edges by slowing down the progress of schools necessary for their respective communities, the design and specifications of these schools responded to the needs of some communities that had expressed themselves in their favor [...] (Gonzalez-Calderon, 2006:17358).

In an interview with architect Steinhardt, the DEPR Secretary César Rey commented that *School Boom* was not adequate for the local context due to the building's large scale and envisioned that the New School project could provide buildings with a more intimate scale, adequate for the environment and surrounding community (Steinhardt, 2002:13). The project led by architect Manuel Bermúdez was characterized by an ample community participation in decision making processes. Besides design and construction professionals, focus groups included sociologists, environmentalists, educators, and community leaders, among others. Furthermore, students at the School of Architecture in the University of P.R. were also invited to conceptualize the new school. The project also included the development of design and construction guidelines and the design of a model school (Bermúdez, 2002:9).

The project's vision statement expands on passive design concepts from the 1950's, expressing that the new Puerto Rican school should (1) reflect the educational, tropical, and Caribbean reality; (2) must be a centre for the community, culturally and socially, while adding that it should also serve as refuge during natural disasters (3) it must have an attractive architecture, compatible with the community's culture,

and idiosyncrasy and (4) the school must be an example of energy conservation, taking advantage of the benefits of the tropical climate (Bermúdez, 2002:12). The preoccupation with environmental aspects and the use of passive design concepts continued during the 21st century, this time, complemented by active technologies. This was evident in the design of the first public Eco School in Puerto Rico, located in Culebra by architect Fernando Abruña, followed by the Ecological School in Dorado.

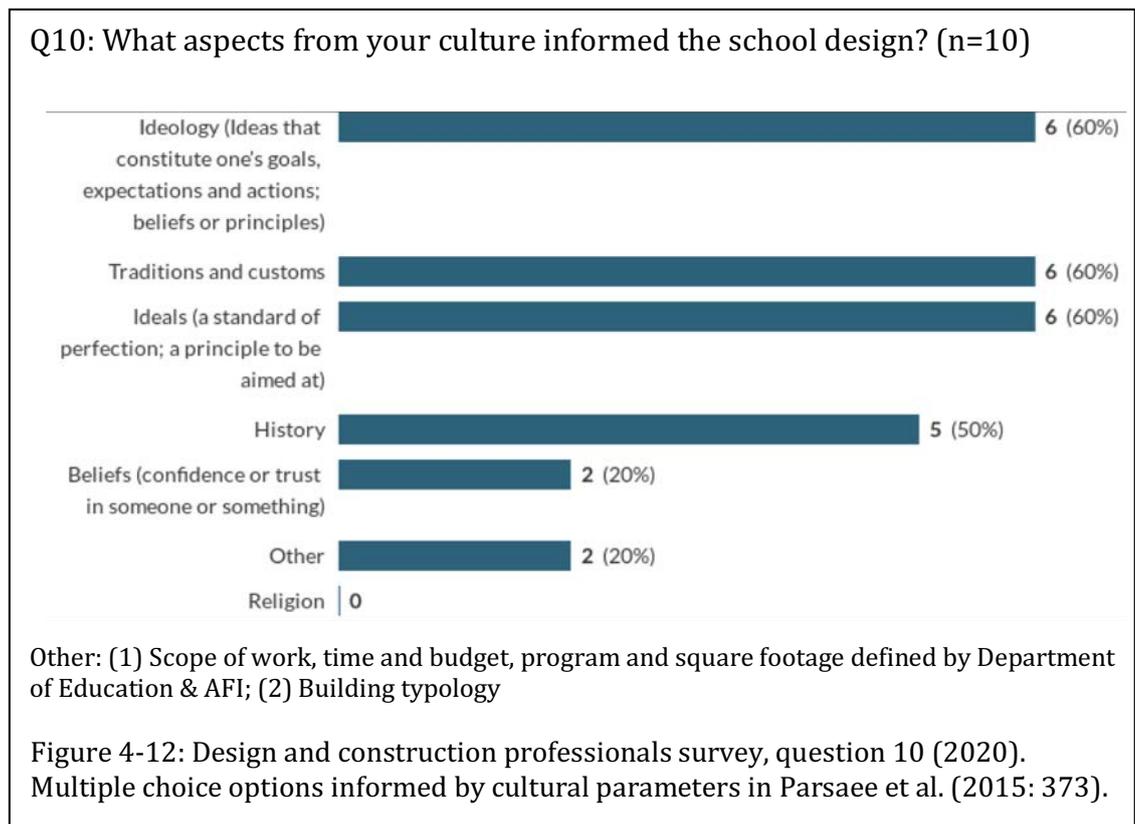
Many of these concepts were also implemented in the Schools for the 21st century federally funded project (2010) under the Progressive Party administration. The American firm Fielding Nair International (FNI) was hired to assist in the development of the school master planning and design guidelines. The firm performed an assessment of local schools and held focus groups and workshops with school directors, teachers, students, and the community to gather their input (Fielding Nair International, 2010a). The research and guidelines used for the design and development of the school modernization project and the participants' feedback is still relevant today and were used as reference for this research. Even though there were approximately 81 or 5.5% of schools impacted by the project, the remaining ones could benefit from these findings since the current general issues are similar.

A total of ten (10) schools were LEED certified as part of this program to demonstrate their compliance with environmental considerations and equate local schools to those in the U.S. Local professionals oversaw the guide's implementation and school design-build process. FNI guides served as reference for the project while also allowing each school to have its particular identity even though they shared common elements such as colours, materials and furniture.

It is important to emphasize that passive design concepts were employed in all 21st century case study schools, even though these are not expressly recognized in the American certification system LEED. A reference to earlier tropical architecture strategies and other historical models was evident in the survey administered for this research (2020). When asked about what aspects from culture informed their school designs, 60% of architect-participants responded "Traditions and customs",

while 50% selected “History” (Figure 4-12). References to previous models are evident through the use of passive design strategies and a modernist vocabulary, as will be further explained on chapter 7. It is important to highlight that two (2) of the participants interviewed pointed to school research projects they had previously done that were influential to their school designs. Their research was also used as reference for this study.

A change in political administration in the next election, generated changes to the 21st Century project. Its name was changed to “Schools First” and several additional schools were remodelled but the project ended due to limited funding (Negociado de Telecomunicaciones, n.d.).



After the case study schools were built, Hurricane María (2017) and the 2020 6.4 Earthquake made visible the vulnerability of the existing local schools and the importance of securing the physical infrastructure. Besides damages caused by the Category 5 hurricane, older buildings that followed earlier PBA prototypes suffered

from the short column effect and collapsed or were severely damaged during the earthquake. For this reason, current school rehabilitation projects post Schools for the 21st century project (2021-22) are focusing on school infrastructure and retrofitting older buildings (Metro, 2022).

This research aims to contribute to this process by articulating a series of LEED credits adapted for the school context of Puerto Rico that could serve as guideline, while taking into consideration the respect for the natural surroundings, as stated in the DEPR mission statement (“P.R. Department of Education,” n.d.). This information will be used to determine what LEED credits are necessary for improving public schools in Puerto Rico and strengthening cultural sustainability.

4.3. Conclusions

The previous sections discussed how political, economic and social changes have affected the local culture and its architectural response. Four (4) main events or turning points were identified, namely the Spanish colonization (1493), American invasion (1898), Industrialization (1947) and Commonwealth (1952), which have brought about changes to school architecture. Different visions and models have been developed for local schools, some employ tropical design strategies and emphasize on environmental concerns while others are more focused on creating enclosed artificial environments that depend on artificial light and air conditioning. In all instances, foreign models have been adapted to the local context, to a larger or lesser degree.

Even though the Island has experienced changes in political dominion due to its colonial status, total displacement of Puerto Rican values has not been achieved, furthermore, these cultural differences have evolved into a new *identity of difference* (Bhabha, 1994:175). This hybrid identity is evident in architectural design, the education system, the coexistence of the Spanish and English language, history, adopted symbols, national heroes, rituals, literature, arts, heritage and customs, evident in schools and other third spaces. This research points to school architecture as a spatial response for a hybrid culture. For this reason, the schools for the 21st

century was selected, considering it synthesizes historical aspects to date and represents the evolution of the Puerto Rican school model.

The analysis presented in the previous sections identified several strategies that have been part of P.R.'s architectural tradition and influenced the designer's response in 21st century schools, including: (1) the patio as an organizational element; (2) the use of passive design to promote natural lighting, ventilation, and rainwater collection both to take advantage of the tropical climate but also to compensate for limited material and economic resources; (3) Amaral schools' modular design, as well as interior layout and building systems flexibility that promote building reuse; (4) administrative areas that are located near the entrance facilitate visual and access control, while also promoting street presence; (5) the development of design guidelines in School Boom 2000 to achieve a school's individual identity, while also specifying certain elements common to the project; (6) the New School's documented participatory processes, in which the school becomes part of the community by becoming a social and educational centre afterhours, as well as a refuge during emergencies. This project marks a return to environmental considerations and tropicality, different from previous air-conditioning dependent prototypes. The tropical discourse and passive design strategies influenced the designer's response to the sustainable challenge in green schools designed by architect Abruña and the Schools for the 21st century project. Passive and active technologies were employed to comply with LEED foreign guidelines in order to measure sustainability in local schools.

While the next chapter will explain the methodology employed to analyse 21st century case study schools, Chapter 7 will analyse more in detail its buildings, concepts, sources of inspiration and strategies employed in the school designs. Chapter 8 will present the proposed LEED credits and the revision of existing ones adapted to the local context, influenced by the architectural strategies summarized above and employed in case study schools.

Chapter 5: **Research Methodology**

5.1. Introduction

The literature review and in-depth analysis of LEED and Sustainable Assessment Systems (SAS) worldwide identified the need for developing cultural indicators and regionalization strategies to better adapt LEED for the local P.R. context (Chapter 2). This justified the need to advance an innovative methodology and data collection strategies considering key concepts such as cultural vitality, identity, sense of place (SoP) and cultural expression, which were considered during the LEED version 4 Impact Categories (Owens et al., 2013) but not fully developed as measurable indicators (Chapter 3). Also, postcolonial theories were identified as key for understanding Puerto Rico's cultural identity, its relationship with the United States and the imposition of building codes, regulations, and certification systems in the local context.

The methodology is aligned with the research conceptual framework (Chapter 3) that references Henri Lefevre's Conceptual Triad to identify schools as cultural spaces. This investigation focuses on *conceived spaces*, term coined by Lefevre, that refers to the space defined by design and construction professionals. A mixed methods research, which included a survey and interviews to architects, engineers, and sustainability consultants of case study schools, was employed to investigate the building design and construction process.

This chapter will follow the Methodological Framework structure (Figure 5-1), which includes the research paradigm, design and techniques employed to assess and evaluate applicable sustainability criteria that could be incorporated into the LEED SAS (R04). Results will aim to answer the following research question: What credits should be added, modified or substituted to develop a revised LEED model for Puerto Rico's socio-cultural context?

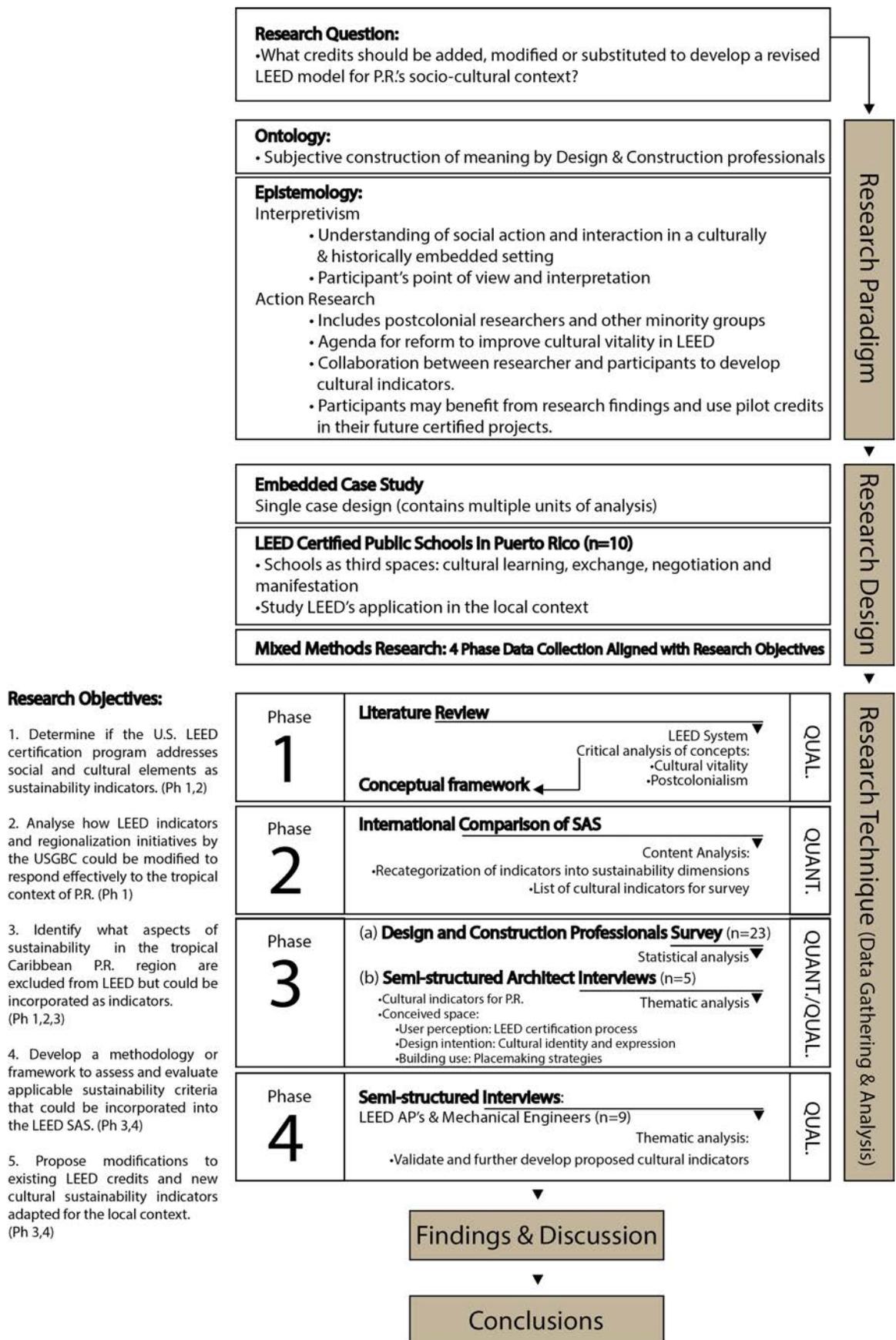


Figure 5-1: Methodological framework (by author)

This chapter is organized in the following sections: Section 5.2 explains the research paradigm and justifies the influence of the Subjective Ontology, as well as the Interpretive and Action Research epistemologies. Section 5.3 discusses the Research design, including the selection of case study schools and mixed methods research techniques, as aligned with the research objectives. Also, discusses the validity and reliability strategies employed on the investigation. Lastly, Section 5.4 provides a summary of the Findings and Discussions that will be explored throughout the next chapters.

5.2. Research Paradigm: Epistemological and Ontological Considerations for Developing Cultural Pilot Credits

The research paradigm is a set of principles, beliefs or assumptions that guide how the researcher views, interprets and acts in the world (Cresswell, 2014:35; Kivunja and Kuyini, 2017:69). The two main **philosophical dimensions** to distinguish or explain existing paradigms are ontology³⁶ and epistemology³⁷ (Wahyuni, 2012:69). While the first focuses on the nature of reality, the latter focuses on the nature of knowledge and how we know what we know (Sarantakos, 2013:29).

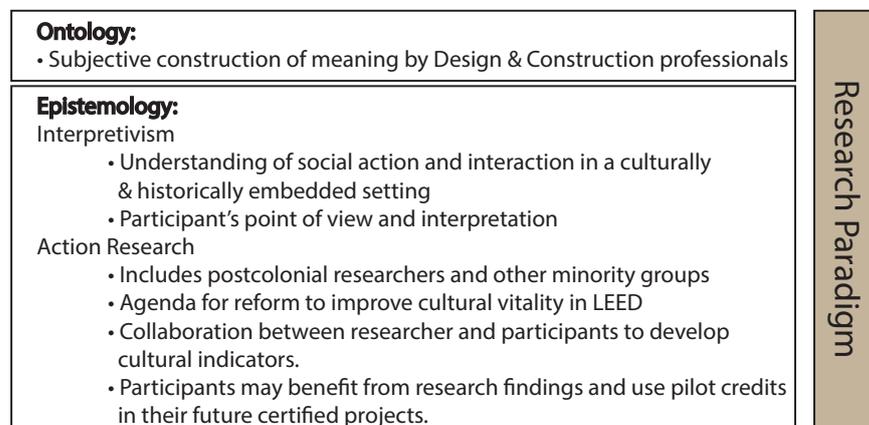


Figure 5-2: Research Paradigm section from the Methodological Framework (by author).

³⁶ Ontology deals with the nature of reality and can be divided into two perspectives: objective and subjective. The first, considers the existence of reality independent of social actors and their interpretations. However, the latter entails that reality is made up of the perceptions and interactions of individuals (MacIntosh and O’Gorman, 2015: 56–57; Wahyuni, 2012:69).

³⁷ Epistemologies include Positivism, Realism, Interpretivism and Action Research (Bryman, 2012; MacIntosh and O’Gorman, 2015).

This research was guided by the Subjective Ontology and the Interpretivism and Action research epistemologies, as will be further explained throughout this section. Both the Subjective Ontology and Interpretive Epistemology served as reference to determine the methodology and select data collection methods that promote the interpretive understanding of social action and interaction on a culturally and historically embedded setting (Crotty, 2014:67). As shown in Figure 5-2, this investigation explores the **Design intention or subjective construction of meaning by design and construction professionals** through mixed methods research. Both the survey instrument and interviews were designed to investigate meaning and meaning making of P.R.'s cultural identity from the participant's point-of-view. Furthermore, to explore how architectural references and sources of inspiration were culturally translated into their contemporary school designs.

When adopting an interpretivist stance, the researcher attempts to see things from the participants' perspective. However, there is a double interpretation in which the researcher also provides an interpretation of participants' views in the data examination process (Bryman, 2012:31). Participants expressed views on cultural identity meaning and expression were examined during the researcher's thematic analysis. Furthermore, the analysis will be interpreted in terms of concepts, theories, and discussions of the discipline such as cultural vitality, Lefebvre's conceptual triad and the placemaking lens,³⁸ which informed the proposed Methodological Framework and development of LEED cultural indicators (Figure 5-1).

This research is in line with previous interpretive studies that reference Lefebvre's triad (lived, conceived, and perceived spaces) to better understand the social dynamics of space. For example, Pierce and Martin (2015:1295) employ the concept of place to address the epistemological challenges of operationalizing the spatial triad while analysing a single strand. Analytically they acknowledge that each part belongs to a whole, but methodologically they can be studied separately.

³⁸ Placemaking analysis included access and linkages; sociability and participation; uses and activities; comfort and image and design categories.

As the focus of this investigation is to understand the abstract- mental or conceived space, we will reference the concept of Placemaking as a way of operationalizing the triad. This is also aligned with the analysis presented on Chapter 3, in which we proposed including applicable Placemaking strategies (Project for Public Spaces, 2009) in LEED to engage **building users** and promote their active role in the making of place and their own culture.

Human action and experience is fundamental for the interpretive **Phenomenological approach**³⁹ (Gottdiener, 1993:131) and also guided the development of several survey and interview questions designed to build a cultural profile of schools in P.R. Questions focusing on design intention, explored issues such as: symbolization; the use of language or words to describe the project; cultural aspects that informed the design and architectural elements employed that contribute to the expression of Puerto Rican culture, among others. It is important to point out that while initially the methodology included Participant Observation in schools, this was not possible due to the limitations previously expressed in Chapter 3 (COVID, Earthquake). Instead of using phenomenology as experience in the building, the research project focused on design and construction professional's experience as LEED users.

Furthermore, the research will reference phenomenologists such as Christian Norberg-Schulz, Steen Eiler Rasmussen and Juhani Pallasmaa for the analysis of local schools and participant's expressed views. While Norberg-Schulz (1980) theories will be explored to understand the concept of "symbolization" and determine the "character" or general atmosphere of the place, Rasmussen (1964) will inform

³⁹ Phenomenology views human action as a product of how people interpret the world and ascribe its meaning. Phenomenology recognizes that we are born into a world with meanings that shape our thinking and behaviour through a process of enculturation. However, it invites us to question our whole culture, our manner of seeing and being in the world and make sense of the phenomena in our world by direct experience and with a renewed mind (Crotty, 2014:81).

discussions about the architectural elements employed in the design such as solids/ cavities, colour, scale and proportion, rhythm, texture and daylighting.

Also, this research will reference Juhani Pallasmaa (2012) who argues that meaning and meaning making in architecture is directly linked to the user's multisensory experience in the space. This is particularly important in architectural design for tropical climates where sunlight, shadow, natural ventilation, and other passive design strategies are frequently employed and are of outmost importance. The question being, does LEED recognize or promote the implementation of these strategies in the sustainable building certification process? If so, how? How can more qualitative aspects of place be integrated for the development of the new LEED cultural credits?

In this research, the development of LEED indicators was guided by the **Action Research**⁴⁰ epistemology, which includes "postcolonial researchers" and other groups with an "[...] action agenda for reform that may change [or improve] lives of the participants, the institutions in which individuals work or live, and the researcher's life" (Cresswell, 2014:38; MacIntosh and O'Gorman, 2015:63). We determined that the most effective "political" strategy was to work for the improvement of the LEED system in P.R. as it may affect plausible change in a shorter time frame but also serve as a way of developing a methodology that could be applicable to other SAS and regions for the recognition of cultural difference.

The research reform agenda is a response to the "imposition" or mandatory use of the LEED "infrastructure" on several Schools for the 21st century federally funded projects. This "infrastructure" comprises "standards and ideas that control everything from technical objects to management styles", also the rules that promote the development of reproducible and generic buildings (Easterling, 2016:9). This concept is also relevant to better understand Lefebvre's conceived space, which is constituted by the intersection of knowledge and power, in which infrastructures are

⁴⁰ Action Research is also known as the Transformative Philosophical Worldview (Cresswell, 2014:38).

located. In his view, it pertains to those who wish to control the social organization and the space of everyday life (political rulers, economic interests, planners) (Pierce and Martin, 2015:1293).

To investigate conceived spaces, the survey and interviews to design and construction professionals of certified schools inquired about strategies professionals used to resist or challenge the LEED infrastructure while complying with the certification requirements. Also, discussed user perception and the participant's professional experience with the LEED certification process of their school. Topics included, but were not limited to, their level of satisfaction and adequacy of this SAS to measure sustainability in the local context. Also, explored social, cultural, environmental, economic, or political factors that promote or hinder LEED's application in Puerto Rico.

In line with other studies (Barr, 2011; Myllyviita et al., 2013; Myllyviita and et al., 2013; Rosenström and Mickwitz, 2004), methodological strategies were designed to promote participation and collaboration between the researcher and expert participants in the development of sustainability indicators. For example, design and construction professionals of case study schools helped prioritize, design, and validate proposed cultural credits. The inclusion of design and construction professionals in the Pilot Credit (PC) development processes ensures that the proposed modifications are relevant for the local cultural context and meet user needs. Furthermore, it may also promote sense of pride and belonging amongst professionals who participated in the research process. This may motivate participants to employ the proposed credits in their future projects or as part of the LEED recertification process of existing local schools, to earn the LEED's Operations and Maintenance certification.

5.3. Research Design and Techniques

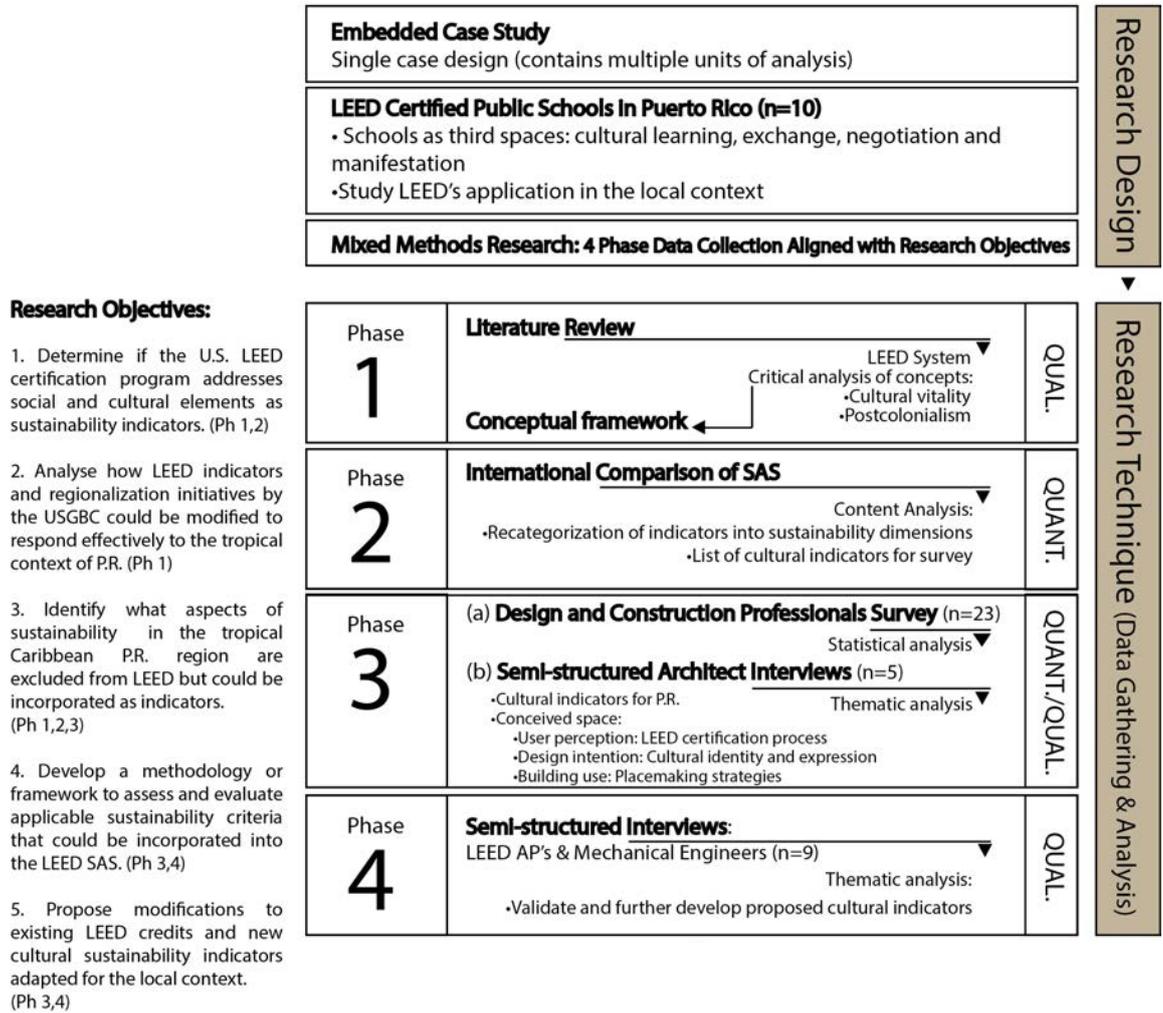


Figure 5-3: Research Design and Techniques sections from the Methodological Framework (by author)

The research design is the framework or structure that guides the selection and execution of a research method, as well as data gathering and analysis techniques (Bryman 2012:45). To explore sustainable architecture and the LEED infrastructure in the Island, all ten (10) certified public schools were examined out of a total of 849 (NCES, 2021). This is considered an **Embedded Case Study**, in which a single case design contains multiple units of analysis (Yin, 2012:7-8). A **Mixed Methods Research**, combined both quantitative and qualitative strategies, as illustrated on Figure 5-3. In the next paragraphs, we will describe how this four (4) phase research design aligns with the five (5) research objectives (RO).

To determine if the U.S. LEED certification program addresses cultural elements as sustainability indicators (**RO1**), an in-depth literature review and analysis of LEED was carried out (Phase 1). An International Comparison of Indicators in school SAS (Phase 2), including LEED, demonstrated that criteria focus mainly on targeting the environmental dimension of sustainability. This suggests the need to further develop LEED's sociocultural components, particularly cultural aspects, which are overlooked worldwide (Chapter 3). Even though this research focuses on the cultural dimension, it is important to acknowledge that all sustainability dimensions are intertwined.

The analysis of LEED indicators and regionalization initiatives by the U.S. Green Building Council (USGBC) (**RO2**) informed the implementation strategy for the research findings, which includes the development of Pilot Credits to better adapt the system to the local context and improve its effectiveness in measuring sustainability in P.R. To identify what aspects of sustainability⁴¹ in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators (**RO3**), the literature review also included concepts such as cultural vitality and Postcolonialism to better understand the application of LEED in the Island.

A methodology or framework was developed to assess and evaluate applicable sustainability criteria that could be incorporated into the LEED SAS (**RO4**). A quantitative online survey was administered to the Architects, Engineers and Sustainability Consultants (LEED AP's) of the selected eight (8) schools on the mainland to inquire about culture and the LEED certification process (Phase 3a). The survey accomplished a 76% completion rate (n=23/30), exceeding expectations. As part of the survey, expert participants were asked to prioritize and select between thirty-nine (39) indicators based on their relative importance for cultural vitality in the P.R. school context. Quantitative data analysis methods were employed sequentially to determine the final list of indicators. Based on comparable studies (Green, 1982; Naughton and et al., 2017; Walsh and et.al., n.d.), selected credits had

⁴¹ Sustainability includes environmental, economic, social and cultural dimensions.

a mean of 3.25 or higher and were considered important by more than 70% of respondents. Also, applied Tastle & Wierman's (2007) formula to determine **consensus** among expert participants, as will be further explained in Chapter 7. A total of thirteen (13) indicators fulfilled these requirements.

Five (5) case study schools were then selected for in-depth analysis based on the Department of Education of P.R. Educational Regions distribution. Regions with the most LEED certified "new construction" projects were prioritized (Figure 5-4). Qualitative semi-structured interviews were performed to the five (5) licensed Architects who designed the green schools located in Regions I and II, obtaining a 100% completion rate (Phase 3b). Interview questions were designed to give participants the opportunity to delve into their survey responses and provide concrete examples. While region names will be identified throughout the text with a roman numeral, Questionnaire Participants (QP) or Interview participants (IP) will be identified with a random letter that represents the school name and a number next to it, to protect participant's identity.

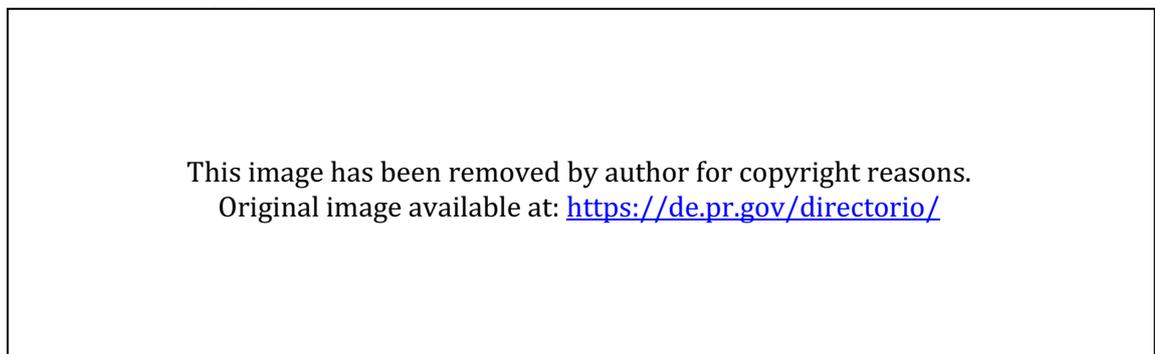


Figure 5-4: Case study selection based on Educational Regions by the P.R. Department of Education. While regions are indicated in color, schools are identified with a letter. Regions are not identified on the map for confidentiality (Source: DEPR, 2018, edited by author).

The survey and interviews included a cultural assessment of schools in P.R. to investigate cultural identity and expression in the design of case study schools, focusing on the following concepts in the conceptual framework:

- Design intention: Cultural identity meaning and expression in building design and construction

- Building use: Placemaking strategies employed in case study schools, particularly focusing on socio-cultural spaces and events.
- User perception: Experience and satisfaction with the LEED certification process.

An additional round of semi-structured interviews to seven (7) LEED AP's and two (2) mechanical engineers was carried out (Phase 4) to further develop the thirteen (13) socio-cultural indicators that were preliminarily identified as important in the online survey. In this second round, there was representation from all ten (10) LEED certified public schools in P.R. Participants were also asked their perception on which conditions of the tropical region, support or hinder the application of the LEED certification system in P.R. Research findings from the above-mentioned techniques will inform the proposal of modifications to existing LEED credits and new cultural sustainability indicators adapted for the local context (**R05**).

In this mixed methods research design, the quantitative method preceded the qualitative one, and the research was mostly carried out sequentially (Bryman 2012: 632). However, even though the survey (Phase 3a) and architect semi-structured interviews (Phase 3b) were concurrent, in the same time period, the interviewee had to answer the survey first because his answers would then be discussed during the interviews. Qualitative methods and analysis predominated in this research, following the interpretivist understanding that explores the social world and meanings through participant's interpretation. Research techniques and instruments were aligned with the study objectives as illustrated in the Methodology Matrix table in Appendix D.

Data for this study was collected mainly from primary sources, complemented by secondary sources. Primary data included direct or first-hand evidence about LEED and case study schools obtained from the survey and interviews, as well as photographs and construction documents provided by professionals. Secondary sources collected during the literature review process, that typically described,

discussed, and analysed primary data included books and journals, among others (MacIntosh and O’Gorman, 2015:79).

5.3.1. Validity and Reliability

This research employed several strategies to determine the credibility or validity of its findings such as triangulation and respondent validation. In the triangulation design, both quantitative and qualitative data was collected and analysed to determine convergence, differences, or both. This served to confirm and corroborate the research findings obtained in the survey and interviews. Also, offset the weaknesses of one method with the other (Figure 5-5) (Bryman 2012:390; Cresswell 2014:190).

For respondent validation, in the Semi- structured Architect Interviews in Phase 3b, the researcher would go over the participant’s survey responses as means to delve in certain topics but also to confirm that they understood the questions correctly. In Phase 4, sustainability consultants (LEED AP’s) were interviewed to validate the selection of the thirteen (13) cultural credits resulting from the survey and further develop them. These professionals contributed to delineate the sustainability strategies and documentation requirements needed to submit each new credit for approval. During the online meeting, a document was displayed containing the credit summary and a thematic analysis for each. The blank portions of the table were completed live as means to confirm that the investigator correctly understood their responses, suggestions, and views on their social world.

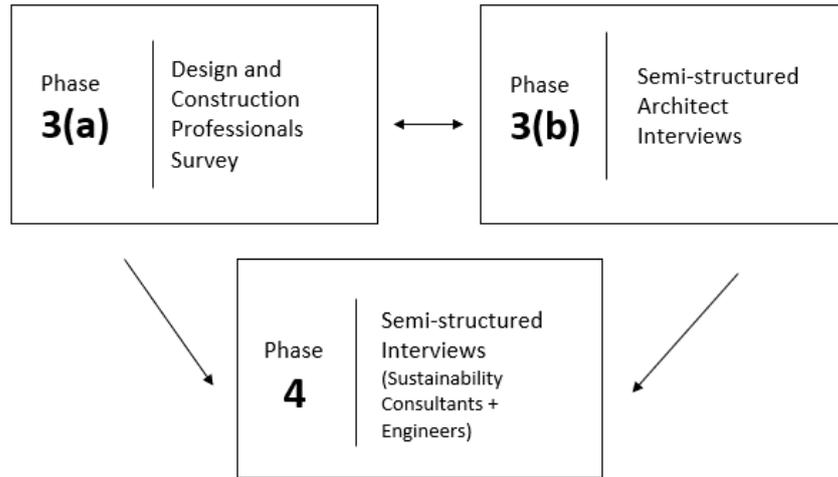


Figure 5-5: Triangulation between phases (by author).

5.4. Findings and Discussion

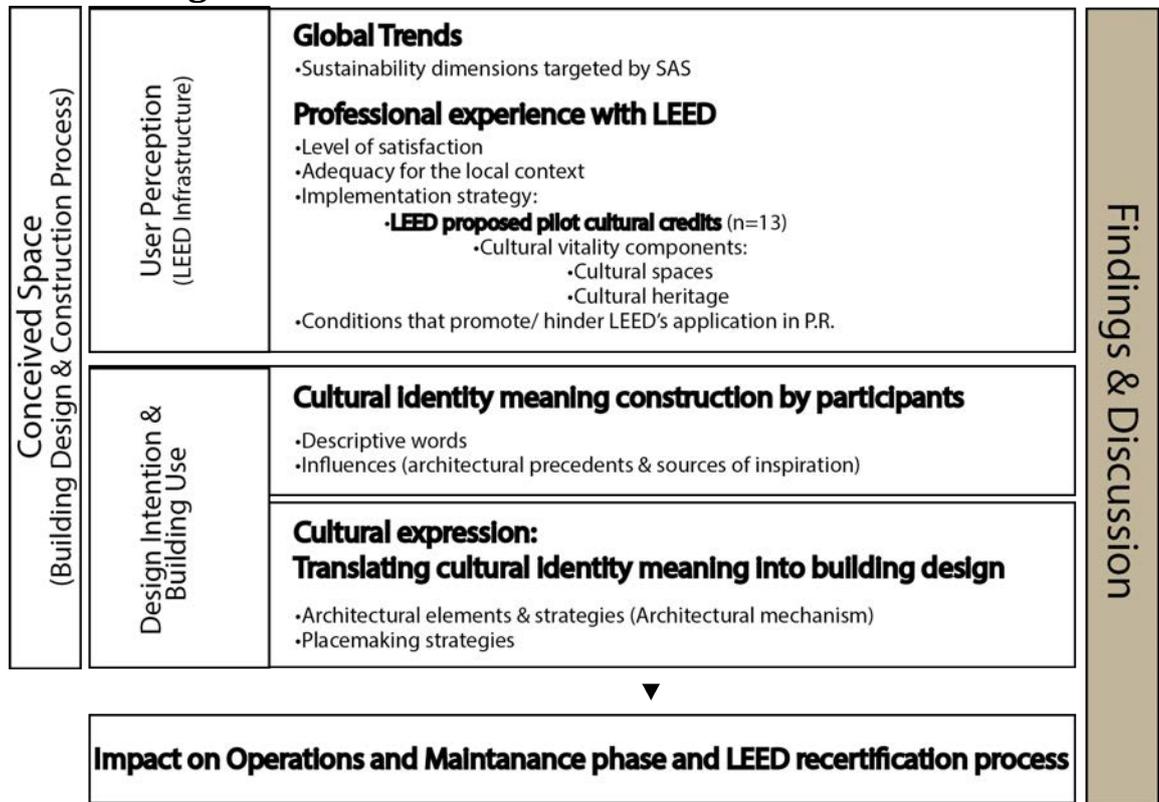


Figure 5-6: Findings and Discussion diagram (by author).

Research findings employed to investigate Conceived spaces and user perception of the LEED infrastructure will discuss global trends, professional's experience, and its adequacy as tool for measuring sustainability in P.R. Proposed cultural indicators will be presented using the USGBC Pilot Credit Application format, which includes the

justification, strategies, and documentation requirements for each credit. The form can be submitted to the USGBC by professionals who want to incorporate these pilot credits in their future LEED certified projects.

Participant's Design Intention and Building use were analysed in the NVivo software informed by the themes shown in Figure 5-6. These will discuss how cultural identity meaning was constructed by participants, particularly focusing on symbolization (Norberg-Schulz, 1980:14) and language (descriptive words) from a phenomenological perspective, as well as architectural influences or precedents which inspired school designs. Participant's meanings of cultural identity and its corresponding expression will be discussed through the Placemaking lens, and the architectural strategies employed by professionals to define the character or atmosphere of their school projects. The next chapters will explain more in-depth the methodology employed in each phase and discuss the research findings based on the parameters established hereby.

Chapter 6: International Comparison of Sustainable Assessment Systems

6.1. Introduction

This chapter will further examine LEED to determine if this certification program addresses cultural elements as sustainability indicators (R01). It also analyses the criteria in Sustainable Assessment Systems (SAS), to determine what cultural aspects of sustainability in the tropical Caribbean region are excluded from LEED but could be incorporated as indicators (R03).

Phase 2	International Comparison of SAS Content Analysis: ▾ •Recategorization of indicators into sustainability dimensions •List of cultural indicators for survey	QUANT./QUAL.
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Figure 6-1: Phase 2 Research Techniques, section from the Methodological Framework (by author).

The next sections will present Phase 2 research techniques, as described in the Methodological Framework, which included a mixed methods content analysis of SAS indicators worldwide (Figure 6-1). Section 6.2 presents an analysis of Cultural Strategies in SAS to inform proposed modifications to LEED in order to strengthen its cultural dimension. Section 6.3 builds up on the analysis presented on Chapter 3 of the LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013: 2), by using LEED's seven (7) IC or sustainability goals as pre-established categories to compare SAS worldwide. It will particularly focus on the *Enhance Social equity, environmental justice, community, and quality of life* IC which includes a brief reference to how buildings impact culture. This IC encompasses concepts such as cultural vitality, Sense of Place, cultural identity and expression, which were discussed on Chapter 3 as key components for cultural sustainability.

This analysis also served to identify patterns and trends, including:

- Which SAS include cultural indicators and what strategies are employed to include them?

- What sustainability goals are targeted by the SAS indicators analysed?
- Are certain sustainability dimensions favoured more than others?
- What indicators may be added, modified or substituted to develop a revised LEED model for P.R.'s socio-cultural context?

Section 6.4 presents Cultural Vitality components and indicators to evaluate their possible inclusion in the LEED for Schools system. The list of cultural indicators generated from this study was included in the survey to design and construction professionals for them to prioritize and select based on their importance for the P.R. school context.

This chapter includes an overview of School SAS, emphasizing on relevant cultural indicators that could be compatible for the LEED for Schools system. In addition to LEED, International SAS for schools included in this analysis encompasses both:

- International SAS, mainstream systems developed mainly in temperate climate countries. These were selected due to their widespread use in the U.S. and abroad or because of their innovative approach for measuring sustainability in buildings, namely: BREEAM, Green Globes, Living Building Challenge and SBTool.
- Context- climate specific SAS developed in tropical regions that included socio-cultural indicators: Green Mark; TERI GRIHA, GRIHA Prakriti and RESET

While this research focuses mainly on Schools, it also includes other compatible residential, commercial and neighbourhood SAS indicators that could be applied to educational buildings, these are: SBAT- South Africa; Casa Azul Seal- Brazil; PCES- Mexico; Tropical Green Building Certification Program (TGBC)- Island Green Living Association, St. John; Green Star Australia Communities; Green Star South Africa; LEED for Neighbourhood Development (ND), DGNB Offices- Germany and JUST, a voluntary certification program for socially just and equitable organizations. Also, SPeAR, which is not considered a certification system, but is a “sustainability decision-making tool” (ARUP 2016), that includes cultural indicators. A brief description of each SAS can be found on Appendix E.

6.2. Cultural Strategies in SAS

As part of this analysis, we referenced the strategies employed by SAS worldwide to include the cultural dimension, and that may also be applicable for the LEED system. These include but are not limited to (1) a flexible framework, (2) the use of pilot credits and (3) the inclusion of a socio-cultural category. For example, the Sustainable Building (SB) Tool is based on a flexible framework⁴² that allows project teams to select indicators from a list based on their applicability for the project. This structure contrasts with the LEED system, which requires compliance with specific indicators to earn the certification. One of the advantages of the SB Tool is that the number of credits and scope can be adjusted depending on the location and project type (iiSBE, 2009). Other SAS that follows a similar structure is SPeAR (Arup, 2012), which also includes a list of indicators for teams to choose from depending on the project conditions. Both systems include a high number of cultural credits within the selection list when compared to other SAS (Table 6-4) and allow teams to attempt those indicators adequate for the region.

Pilot credits have also proven to be a useful tool to propose and test new credits for its eventual adoption and implementation, covering a wide range of topics. These credits can be used as part of the Innovation category in LEED projects or outside a project submittal, by contacting the GBCI (USGBC, 2021:4). Similarly, this strategy has been adopted for the LEED Social Equity Pilot credits (Todd, 2014) and more recently for LEED Safety First Pilot Credits, a COVID-19 response guide (USGBC, 2021c). Other SAS that also include PC are Green Star Australia and Green Star South Africa. The latter, includes a Socio-economic category that can be targeted as a separate certification or individual credits may be used as innovation points (Green Building Council South Africa, 2017). Pilot Credits are the recommended option for the cultural indicators proposed as part of this investigation. We will provide a list of cultural indicators for professionals to choose from based on its applicability for the project and regional conditions. Future research may propose cultural credits to be

⁴² The weighting and scope of the system can be modified from 6 to 120 criteria, as needed, depending on regional conditions (iiSBE, 2009).

marketed as a separate certification in addition to being Innovation credits and consider a flexible framework strategy within LEED.

Once the cultural credits are adopted, they could become part of the main SAS categories, such as in the “Sociocultural and functional quality” category in DGNB (DGNB System, 2022) or “Social, cultural and perceptual aspects” in SB Tool (iiSBE, 2009). However, additional credits with cultural content were identified under other categories in the latter, which demonstrates an overlap between sustainability pillars.

6.3. International Comparison of School SAS

6.3.1. Methodology for Comparing SAS

This investigation employed a **mixed methods** design to conduct a **content analysis** to compare LEED categories and criteria, with both international and context-climate specific green rating systems that have emerged in tropical countries. While the research mainly identified qualitative themes targeted by SAS worldwide, also generated statistics and percentages to facilitate comparison between the systems. The study included a total of 16 SAS⁴³ and three (3) additional references on cultural sustainability⁴⁴ (Barr, 2011; Rosario Jackson et al., 2006; United Nations, 2014) that generated a list of **1,462 indicators**. Indicators were obtained from SAS manuals current version, at the time of analysis (2016-2017), available through the organization’s website. A comparison between LEED and these SAS informed what indicators may be added, modified or substituted to develop a revised LEED model adapted for P.R.’s socio-cultural context.

⁴³ SAS analysed (n=16): LEED V4 (2013); BREEAM (2016); SB Tool (2015-16); Living Building Challenge 3.0 (2012); Green Globes V1.4; RESET-Costa Rica; Green Mark-Singapore; GRIHA-India; SBAT-South Africa 1.04; Casa Azul-Brazil; PCES-Mexico; Tropical Green Building Certification -St. John; Green Star (Comm. 1.0); DGNB Offices 2014, JUST and SPeAR.

⁴⁴ Additional references on socio-cultural indicators and sustainability included: Barr, 2011; Rosario Jackson et al., 2006; United Nations, 2014

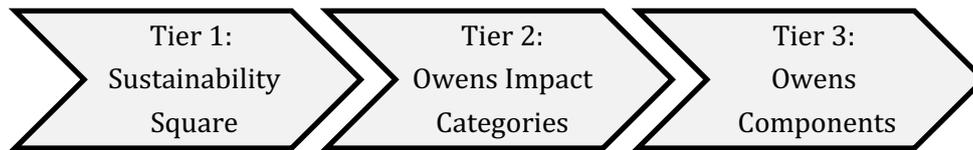


Figure 6-2: Three (3) tier coding system developed for the research

Indicators were added to an Excel matrix and categorized according to the main issues identified using a three (3) tier coding system developed for this investigation, as shown in Figure 6-2. Indicators were classified following the sustainability square, which includes the environmental, economic, cultural and social sustainability dimensions (tier 1) (Ebert et al., 2011:21). Then, they were grouped using the seven (7) Impact Categories (IC) or goals targeted by LEED (Owens et al. 2013: 2), that seek to answer what a certified project should accomplish (tier 2), namely:

- Reverse contribution to climate change
- Promote sustainable and regenerative material resources cycles
- Protect and restore water resources
- Protect, enhance, and restore biodiversity and ecosystem services
- Enhance individual human health and well-being
- Build a greener economy
- Enhance social equity, environmental justice, community health and quality of life

It is important to point out that this document also provides a general definition, components and measures for each IC that served as guide and reference during this [re] categorization process. For example, Table 6-1 summarizes information obtained from Owens et al. (2013: 2) for the *Enhance social equity, environmental justice, community health and quality of life* IC, particularly the *Sense of Place* and *Promote Access to Neighbourhood Completeness Resources* components, which includes the largest number of cultural indicators, as will be further discussed on the next section.

LEED V4: ENHANCE SOCIAL EQUITY, ENVIRONMENTAL JUSTICE, COMMUNITY HEALTH AND QUALITY OF LIFE IMPACT CATEGORY AND COMPONENTS		
IMPACT CATEGORY & DEFINITION	COMPONENTS (KEY INDICATORS)	MEASURES
Enhance Social Equity, Environmental Justice, Community Health and Quality of Life: <ul style="list-style-type: none"> ○ nurtures cultural vitality ○ buildings can shape the culture, politics, values, prosperity, health, and happiness of citizens 	Create a Strong Sense of Place (SoP)	light pollution reduction;
		tree-lined streets;
		views;
		landscaping and green roofs;
		open spaces;
		civic spaces;
		historic preservation;
		connection to the outdoors;
		walkable communities;
		human scale environments;
		cultural expression; freedom to express values/beliefs through building design <i>(++) community participation in decision making processes and governance</i>
Table by author, emphasizes on the cultural aspects in LEED referenced in Owens et.al.: 2013.		

Table 6-1: LEED V4: Enhance Social Equity, Environmental Justice, Community Health and Quality of Life Impact Category and Components

Each indicator was further classified using the IC's components or key indicators in Owens et al. (2013: 2) (tier 3) as means to validate the alignment between the sustainability pillars and LEED IC's (tiers 1&2). The alignment or match resulting from this analysis is summarized in Figure 6-6 and will be explained on the next section.

The selected methodology is in line with LEED v4's sustainability and performance goal-oriented approach. Even though the analysis is based on version 4, LEED's upgrade to 4.1 is not a full version change, and uses the existing credit requirements as foundation (Baulding, 2021). Even though these IC were developed for LEED, they proved useful to classify indicators in other SAS that target the same wider sustainability goals. Currently, there is no set industry standard and different SAS may have similar indicators grouped into different custom categories, which difficult comparison and made this [re] categorization of indicators necessary.

Table 6-2 presents a sample from the [re] categorization of indicators Excel document developed for this investigation. In this case, the LEED credit *Joint Use of Facilities*, was classified as Cultural (Tier 1) because it encourages that the school shares their spaces with the surrounding community for non-school events. Even though the “cultural” term is not evident at first glance, the credit requirements include a list of socio-cultural spaces that could be lent to the public. It was classified under the Owens et al. (2013: 2) *Enhance social equity, environmental justice, community health and quality of life* IC (Tier 2), particularly under the *Promote Access to Neighborhood Completeness Resources* component (Tier 3) because the community benefits from using the school facilities. The sample measures provided by Owens for this category (see Table 6-1) include “proximity to high quality public education facilities and resources”, which is compatible with this credit.

Certification System Name	Family	Category	Tier 1: Master Credit Typology (4 pillars)	Tier 2: OWENS Impact Category	Tier 3: OWENS Components (Key indicators)
LEED V.4- BD+C: Schools	Sustainable Sites	Joint Use of Facilities	Cultural	Social Equity, Env. Justice, Community Health and Quality of Life	Access to neighbourhood resources

Table 6-2: Excel document sample- Three (3) tier classification system based on the Sustainability Square (Ebert et al., 2011:21) and LEED Impact Categories (Owens et al. 2013).

It is important to point out that credits, such as this one, may target several sustainability pillars and IC. In those cases, we referred to the indicator title, content, and original classification to inform the [re] categorization process. A similar process was done for each of the 1,462 indicators analysed.

To ensure consistency and objectivity during the [re] categorization of indicators process, a coding manual was developed based on Bryman’s (2012: 299-300) methodology, which includes the possible subcategories for each dimension being

coded (See Appendix F). Even though only one researcher coded the information, the coding manual was a useful tool to ensure consistency in the coding process, even though it is almost impossible to develop a coding scheme that does not entail some interpretation from the coder (Bryman 2012: 299). This manual also helped identify any overlaps between the codes and avoid repetition in more than one category.

The Content Analysis and methodology employed aims to quantify content in terms of predetermined categories, and in a systematic and replicable manner so that further research studies are feasible (Bryman 2012: 304). This [re]categorization of indicators in SAS revealed the themes targeted by each pillar and those that were missing, when compared to the literature reviewed. Furthermore, the analysis of global trends revealed which IC or goals can be strengthened in LEED, as well as indicators that could be added or modified. This content analysis allowed us to analyse in- depth cultural sustainability indicators and generate a list of thirty-nine (39) criteria, to be included in the self-completion survey for expert participants to prioritize and select based on the relative importance for cultural vitality in the P.R. school context.

This analysis could also be used as a tool to develop indicators for other sustainability dimensions and could be updated as SAS are revised, and new indicators are launched. The methodology for the [re]categorization of indicators may also be employed by other researchers or SAS representatives to determine if there is a balance between the sustainability pillars being targeted and/ or re-evaluate its priorities. The analysis revealed that some SAS indicators overlap or target more than one pillar. Further research could propose more holistic indicators that target the broad sustainability spectrum, so that the initiatives carried out by the project team could benefit the environment, society, culture, and economy. Further research may analyse in-depth other sustainability dimensions and revisit the credits resulting from this research to add compliance with additional applicable pillars.

6.3.2. [Re] Categorization of Indicators and Analysis of Global Trends

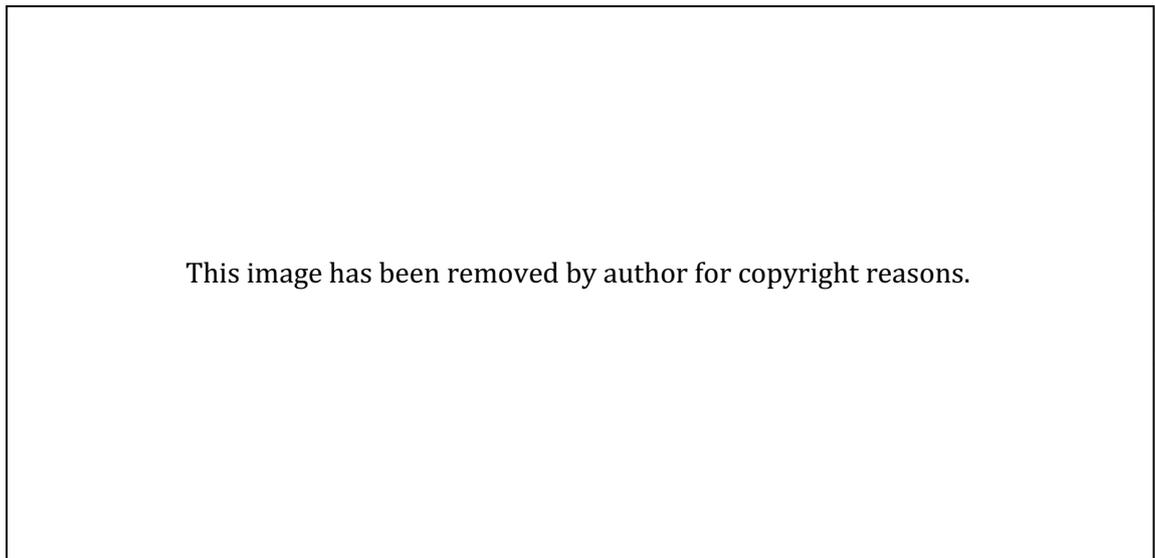


Figure 6-3: World Map showing selected SAS in Tropical, Subtropical and Temperate climate zones. Sources: (Arup, 2012; BCA, 2016a; BRE Global, 2016; Caixa, 2010; Canuckguy, 2006; CSIR, 2015; GBC South Africa, 2014; “German Sustainable Building Council (DGNB),” 2014; Green Building Council of Australia, 2015; GRIHA Council, 2016; iiSBE, 2009; International Living Future Institute, 2014; Intl. Living Future Institute, 2014; “PCES,” 2010; Reed and et. al., 2009; UIA, 2012; USGBC, 2016c).

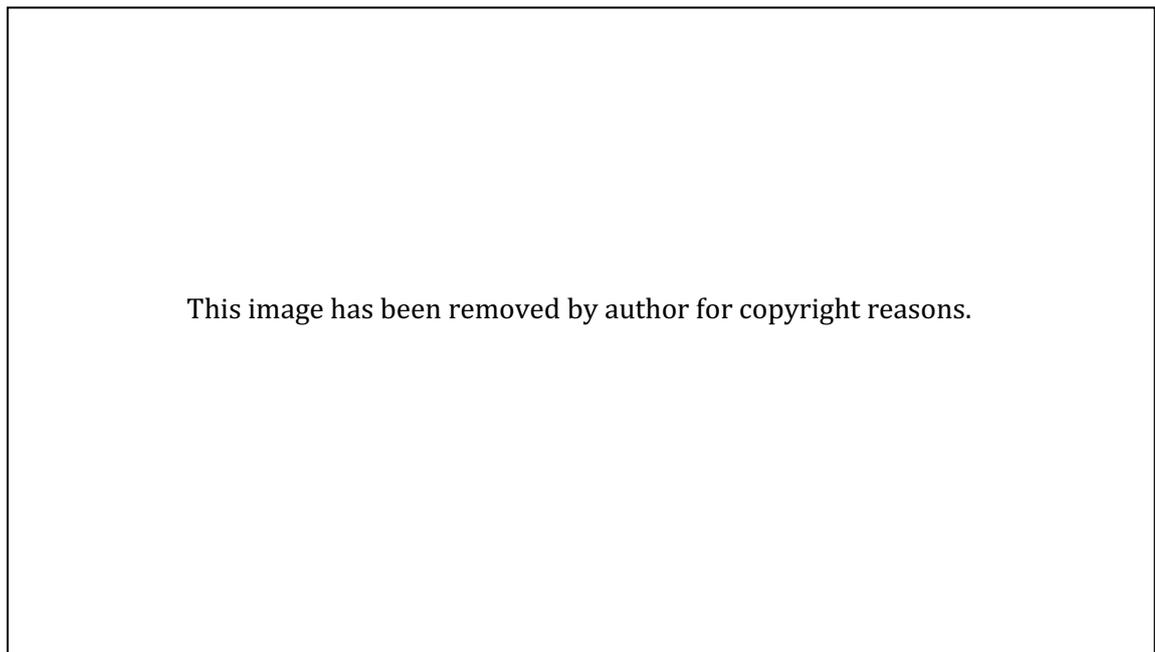


Table 6-3: Timeline of the development of selected SAS: 1990 – 2015. Sources: (Arup, 2012; BCA, 2016a; BRE Global, 2016; Caixa, 2010; Canuckguy, 2006; CSIR, 2015; GBC South Africa, 2014; “German Sustainable Building Council (DGNB),” 2014; Green Building Council of Australia, 2015; GRIHA Council, 2016; iiSBE, 2009; International Living Future Institute, 2014; Intl. Living Future Institute, 2014; “PCES,” 2010; Reed and et. al., 2009; UIA, 2012; USGBC, 2016c)

While this investigation focuses on the Cultural pillar, Economic, Social and Environmental indicators in school SAS, were also initially categorized to present a broad panorama of systems worldwide and identify trends. An analysis of school SAS indicators showed that the cultural pillar lagged behind (4.8%), followed by the economic (13%), social (16.2%) and the environmental dimension of sustainability (66%), which includes the majority of indicators (Figure 6-4).

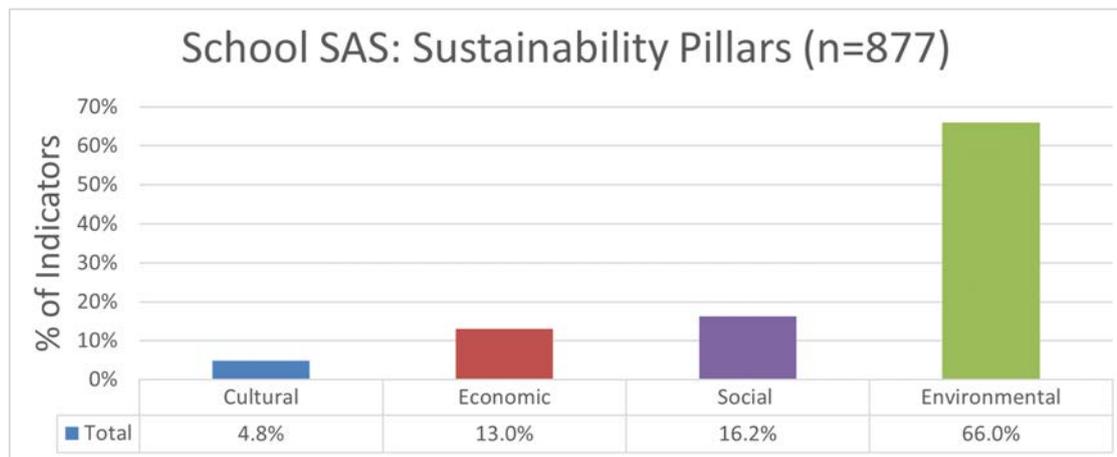


Figure 6-4: School SAS analysis of sustainable dimensions targeted (Tier 1) (n=877)

Out of the International SAS analysed, the Sustainable Building (SB) Tool, has the largest number of cultural indicators (n=24, 2.74%) (see Table 6-4). However, not all indicators are mandatory because SB Tool allows project teams to select from a list those applicable to their project. While SB Tool has the lead internationally with cultural indicators, the RESET SAS (UIA, 2012: 2) developed by the Institute of Tropical Architecture in Costa Rica, has the largest number of indicators in the tropical region (n=13, 1.48%). None of the other tropical systems analysed, namely Green Mark from Singapore and GRIHA from India, included cultural indicators that were clearly identified. However, it is important to underscore that tropical SAS such as RESET and Green Mark, place higher emphasis on passive design than its international counterparts. While these strategies are mainly employed for energy efficiency or user comfort and are classified under the environmental or social pillar, respectively, it was evident on the survey and interviews that passive design is part of the architectural cultural heritage of the region. Refocusing the narrative of these indicators to reinforce the connection between the environment, climate and culture could further strengthen the cultural pillar in tropical SAS and will be considered throughout the credit development process.

SAS Name	Cultural	Economic	Environmental	Social	Total # of Indicators	Graph
International	30	17	467	103	617	
BREEAM Intl.: In Use 2016 (Asset)	1		62	8	71	
BREEAM Intl.: In Use 2016 (BM)			64	7	75	
BREEAM Intl.: NC-2016	4	2	35	18	55	
Green Globes EB- US		1	47	5	53	
Green Globes NC- US (V.1.4)			42	2	44	
LEED V.4- BD+C: Schools	2		47	8	57	
LEED V.4- O+M: Schools	1		39	8	48	
Living Building Challenge 3.0	2		10	8	20	
SBTool 2015-16	24	10	121	39	194	
Tropical	13	6	189	52	260	
Green Mark- Exist. Schools			24	7	31	
Green Mark- New non res. bldgs. 2015			53	10	63	
GRIHA-Prakriti- Existing Schools			10	5	16	
RESET	13	6	76	25	120	
TERI GRIHA			26	5	31	

Table 6-4: School SAS General Pillars

In the next paragraphs we will discuss each sustainability pillar and provide a definition based on the results from the analysis of the LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013) and (re) categorization

of indicators. Also, examine the percentage of indicators that target specific goals in order to determine global trends (Figure 6-5). We will emphasize on the *Enhance Social Equity, Environmental Justice, Community Health and Quality of Life* IC, which is the only one that includes a reference to culture, having *Sense of Place* as its main component. Also, this is the only IC that crosses over the four (4) sustainability pillars, as shown in Figure 6-5. However, components and indicator measures vary under each dimension, as will be further explained.

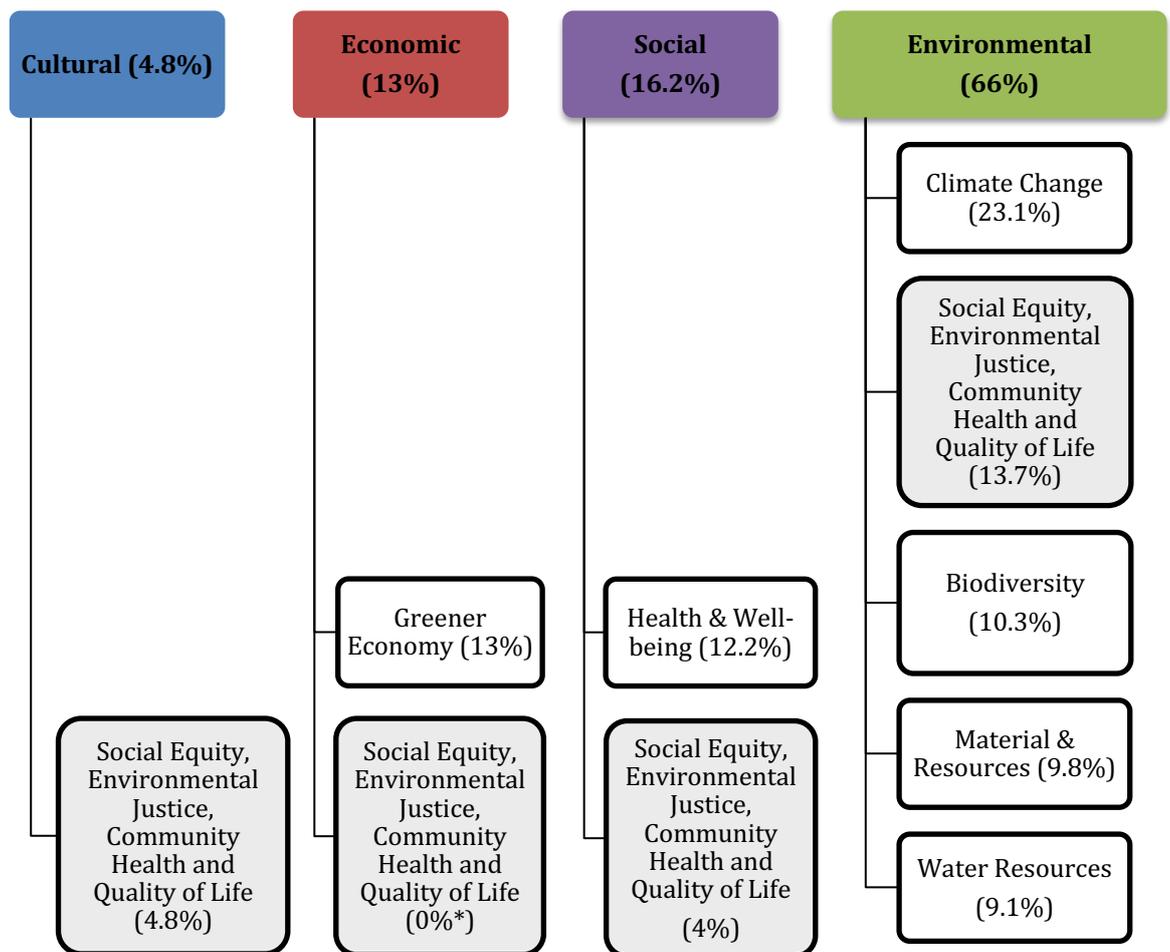
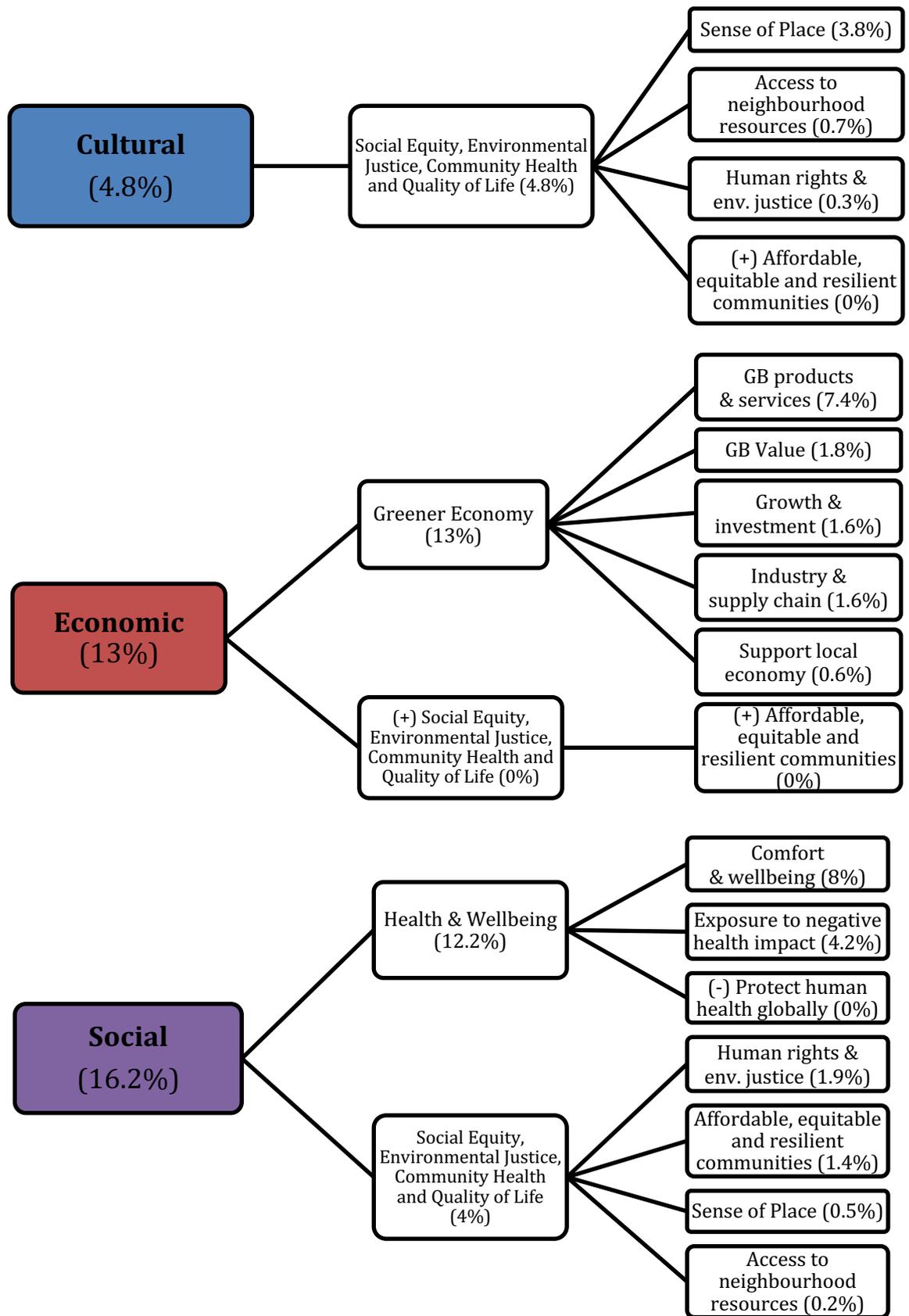


Figure 6-5: [Re]Categorization of Indicators in school SAS (Tiers 1 & 2). Indicates % of total indicators in SAS analysed (n=877 indicators). Diagram by author. Three (3) tier classification system based on the Sustainability Square (Ebert et al., 2011:21) and LEED Impact Categories (Owens et al. 2013).

Key: *Indicators included in compatible SAS, 0% on school SAS.



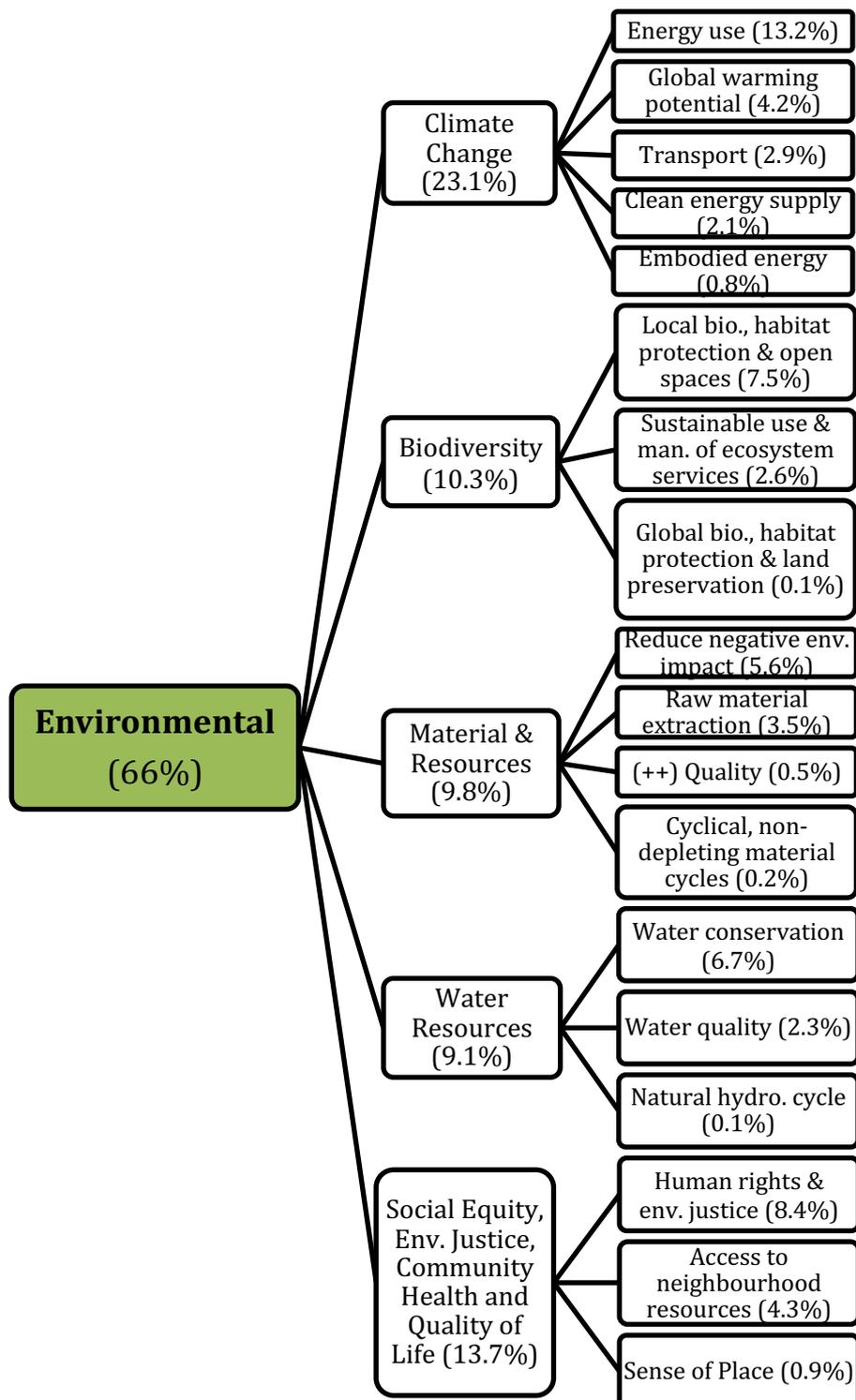


Figure 6-6: Alignment between sustainability pillars, IC and components. Three tier coding system based on the Sustainability Square (Ebert et al., 2011:21) and LEED Impact Categories (Owens et al. 2013). Key: (+) Indicators included in compatible SAS, not on school SAS. (++) Additional goal proposed by author.

- **Cultural pillar:** For the purpose of this study, **culture** is defined as the characteristics of a society, its norms, values, skills, knowledge and beliefs that serve as a guide for an individual or group (Walker 2014; Axelsson et al. 2013). It can manifest itself through intellectual or artistic creativity, while individuals, organizations or institutions, including schools, are responsible for its dissemination (UNESCO, 2001).

SAS cultural indicators were categorized under the *Enhance Social Equity, Environmental Justice, Community Health and Quality of Life* IC components in Owens et al. (2013: 2). Note that the *Sense of Place* (SoP) component under the cultural pillar has the highest number of indicators (3.8%) when compared to the other sustainability dimensions (Table 6-6). This further validates the literature review and analysis presented in chapter 3 where we highlighted the importance of SoP in school communities for achieving cultural vitality:

[...] A stronger sense of place provides means creating more opportunities for cultural, social and recreational interactions, improving community aesthetics, creating a strong sense of identity with the community and a greater sense of connectivity between members of that community. Examples of measures that contribute to sense of place include: light pollution reduction, tree-lined streets, quality views, ecologically-conscious landscaping, green roofs, open spaces, civic spaces, historical preservation, greater connection to the outdoors, pedestrian friendly communities, human scale environments, cultural expression and the freedom to express values/beliefs through building design (Owens et al., 2013: 16).

Even though the document by Owens et al. (2013) defines SoP and gives examples of measures that quantify it and that promote its attainment, the concept is not included as part of the LEED certification manual or specific indicators. For example, Table 6-5 presents an excerpt from the *Social Equity* IC, *Sense of Place* component which includes an indicator that promotes the provision of open spaces (full table is included in Appendix F: Coding Manual). However, it would benefit from requiring that these spaces should be compatible with local values and promote human/nature interactions, such as is required in SB Tool and LBC indicators, respectively. Particularly in P.R., the tropical climate and architectural

heritage favours the inclusion of outdoor learning and socialization spaces in schools.

LEED V4: ENHANCE SOCIAL EQUITY, ENVIRONMENTAL JUSTICE, COMMUNITY HEALTH AND QUALITY OF LIFE IMPACT CATEGORY									
KEY INDICATORS OR COMPONENTS	MEASURES	PILLARS				LEED SAS			OTHER SAS
		CULTURAL	ECONOMIC	SOCIAL	ENVIRON.	ND	NC	OM	
Create a Strong Sense of Place (SoP)	light pollution reduction;				X	X	X	X	
	tree-lined streets;				X	X			
	views;	X					X	X	X
	landscaping and green roofs;				X		X		
	open spaces;	X		X	X		X		
	civic spaces;	X		X		X			
	historic preservation;	X				X			X
	connection to the outdoors;	X							
	walkable communities;			X	X	X			
	human scale environments;	X							X
	cultural expression; freedom to express values/beliefs through building design	X							X
	(++) community participation in decision making processes and governance	X		X		X			
LEED systems key: ND: Neighbourhood Development; NC: New Construction; OM: Operations & Maintenance									
[++] Proposed measure to be added (by author)									
Table by author, emphasizes on the cultural aspects in LEED referenced in Owens et.al.: 2013.									

Table 6-5: Alignment between *Social Equity IC – Sense of Place* component and pillars. The table also indicates if the measure is considered in LEED and/or other SAS.

Furthermore, concepts or measures that are not clearly defined on the Owens et al. document, such as the *cultural expression; freedom to express values/beliefs through building design* measure were further contextualized by looking at Placemaking strategies (PPS, 2005) and other SAS indicators focusing on the aesthetic quality of the project and the inclusion of art and design features that celebrate culture, spirit and place (SB Tool; LBC); the use of traditional materials

and techniques (SB Tool), as well as the integration of the project to the surrounding context (SB Tool, RESET). This further validates the proposition of utilizing the Placemaking concept as a way to operationalize SoP because it portrays an active user, involved in the making of place and its own culture (Chapter 3). Also, because the Placemaking definition includes SoP: “Quality places with a strong sense of place that people want to work, live, play and learn in” (Wyckoff, M., n.d.).

Indicators found in literature review (Rosario Jackson et al., 2006; United Cities and Local Governments, 2008: 21; United Nations, 2014) also promote community outreach and participation in cultural governance. However, there were no compatible measures identified under Owens IC, which is why we propose adding it to the *Sense of Place* component, as indicated on Table 6-5. Even though no indicator was found on the LEED for Schools system, an indicator titled *Community Outreach and Involvement* is available for the LEED Neighbourhood Development system (USGBC, 2022c) and the credit *Expand Citizen Participation* is available on LEED Reli (USGBC, 2020:57). Expert participants also highlighted the importance of school community involvement in decision making processes during the second round of interviews. These credits will be further analysed to strengthen its cultural focus and adapt them to the local context, for its possible inclusion on LEED for schools. User involvement also helps to promote sense of pride and ownership among community members as a Placemaking strategy (PPS, 2005).

While other cultural indicators target the *Access to neighbourhood resources* goal through the provision of shared communal school spaces, those under the *Human rights and environmental justice* component consider education and freedom of speech as a human right, based on the Universal Declaration (United Nations, 1948). This translates into indicators that promote arts and cultural education, as well as communication (internet use). Also, buildings designed for adaptability, that allow further development and internal spaces to be modified (BREEAM, PPS, 2005). This promotes the continuity of cultural heritage into the

future and environmental justice by reducing demolition, construction impacts and preventing pollution. While no indicator in school SAS was identified under the *Affordable, equitable and resilient communities* component, indicators in compatible SAS promote gender equality and cultural diversity, that could be reinforced in socio-cultural spaces. These concepts were included in the Coding Manual available in Appendix F.

As shown in Figure 6-7, LEED for schools, primarily targets the *Access to Neighborhood Resources* through the indicators Joint Use of Facilities and Open Spaces. However, credits such as Historic preservation and adaptive reuse on LEED ND, could be adapted for schools, considering it targets the SoP goal, based on Owens et al. (2013) definition. Other SAS such as RESET and SB Tool has the highest number of credits that target Sense of Place (Figure 6-8). These were also included as part of the list of cultural indicators on the survey as a way to inform which credits could be added in LEED.

This analysis has evidenced that the concept of culture is included within this IC, however, it could be further re-enforced by adding the concept of cultural vitality to its title, for example:

ENHANCE SOCIAL EQUITY, ENVIRONMENTAL JUSTICE, COMMUNITY HEALTH, CULTURAL VITALITY AND QUALITY OF LIFE IMPACT CATEGORY AND COMPONENTS

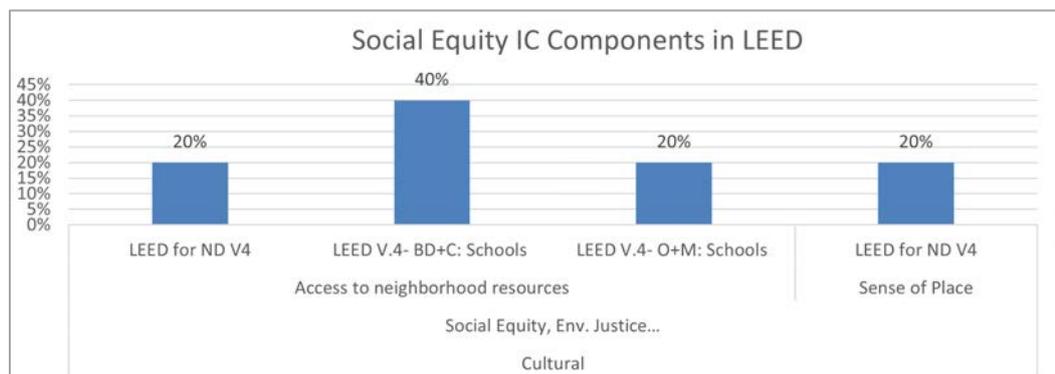


Figure 6-7: Social Equity IC Components in LEED

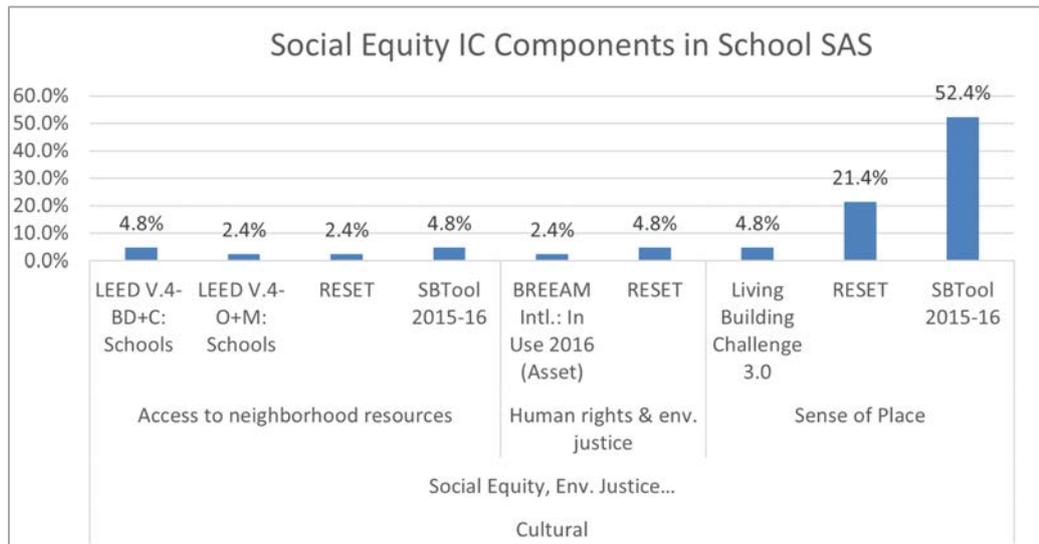


Figure 6-8: Social Equity IC Components in School SAS

- Economic pillar (13%):** As shown in Figure 6-6, most indicators aim to propel a Greener Economy, focusing on raising awareness of the advantages of sustainable buildings and promoting the industry, its products and services, while incentivizing long-term growth and investment opportunities. Even though Owens et al. (2013: 2) mainly focuses on promoting a market change, other compatible certification systems such as the JUST organizational label, includes indicators that fit under the *Social Equity IC component Affordable, equitable and resilient communities* such as stewardship, charitable giving, and community volunteering. This was included as part of the Economic pillar diagram due to its possible applicability on the school context. Indicators that focus on cultural economy, overlap both pillars, but were placed together with the cultural indicators in order to be able to include them on the list of credits for expert participants to prioritize on the survey. Similarly, “green building education” is categorized by Owens et al. (2013: 2) under the *Green Building Value* component. However, education is a topic that crosses over all four (4) pillars, depending on its focus or emphasis. Its classification under the economic pillar promotes the interaction of occupants and visitors with the building’s sustainable features to emphasize on the value, savings and investment of environmentally-friendly strategies. On the contrary, other indicators that promote cultural education; professional development and skills training were classified under the cultural and social pillar, respectively. This distinction was added to the Coding Manual

developed for this investigation. It is important to point out that no economic indicators that contribute directly to SoP were identified based on Owens et al. (2013:2) definition of this IC, further research could be done to strengthen this component on this pillar.

- **Social pillar (16.1%):** Indicators classified under this dimension prioritize the “individual, family, or individuals in a society” and their interaction (Axelsson et al., 2013:215; Merriam-Webster, n.d.). Based on similar studies (Axelsson et al., 2013, p. 2018; Rosenström et al., 2006, p. 193), user related aspects that enhance health, well-being and support occupant comfort (12.2%) were also classified under the social sustainability component and include the highest number of indicators in this category, as illustrated on Figure 6-6. Social indicators under the *Social Equity* IC (4%) target all four (4) components, being *Human rights and environmental justice* the one with the largest amount of indicators in this pillar (1.9%) focusing on professional development and skills training (JUST, Selo Casa Azul, SPeAR), personal security, and workplace safety all considered a human right, based on Articles 3, 25 and 26 of the Universal Declaration (United Nations, 1948). This component also encourages local food production in communities (SB Tool, SPeAR, LEED ND), while promoting user engagement and sense of ownership. Indicators such as this one may be refocused to strengthen its cultural component and regional application. For example, during the interviews, one of the participants commented that their agricultural/ vocational school design included a plot of land for each student to plant on (IP-D1). This Placemaking strategy relates to P.R.’s agricultural heritage, which was the main economic activity until the late 1950s, and currently is still part of the culture of the mountainous region the school is located in. These nuances provided by professionals during the interviews will help further root indicators to the local context and enrich the selected credits based on participants experiences, recommendations, and school needs.

Affordable, equitable and resilient communities component indicators foster equity and equality⁴⁵ of community constituents. Also, universal design and accessibility, which are of utmost importance for the design of socio-cultural spaces analysed in this research and are also a Placemaking strategy to promote inclusivity (PPS, 2005). This social component has the highest number of indicators (1.4%), when compared to the rest of the sustainability pillars in Table 6-6.

Sense of Place component indicators in Table 6-5, classified under the social dimension, include community outreach and involvement in decision-making processes, project design and management (LEED ND, SB Tool, SBAT), in contrast to cultural governance that focuses on the development of “policies for the protection and promotion of culture, cultural rights and cultural diversity” (CSIR, 2015; iiSBE, 2009; United Nations, 2014; USGBC, 2014b). Also, encourages projects that “provide facilities for community or public benefit, which respond to the socio-economic needs or assets of identified communities or stakeholders” (Green Building Council South Africa, 2014). While also providing *access to neighbourhood spaces* for leisure, socialization and recreation.

- **Environmental pillar** (66%): As shown in Figure 6-6, this pillar includes the highest number of indicators and aims to *Reverse the contribution to climate change* (23.1%) focusing on GHG emissions reduction from energy use and transport; greater adoption of renewable energy sources and promoting affirmative actions to reduce global warming. Environmental indicators also aim to safeguard, enhance, and restore local and global biodiversity through habitat protection, the provision of open spaces and land preservation, as well as the sustainable use & management of ecosystem services (10.3%). Furthermore, promote sustainable and regenerative material resources cycles (9.8%) by

⁴⁵ While Equity indicators advocate for the fair treatment of employees and subcontractors according to individual needs, equality indicators advance equal rights, benefits, obligations, and opportunities regardless of gender, race, or any other characteristic.

reducing raw material extraction and its negative environmental impacts. Also, advocate for the conservation and quality of water resources (9.1%).

The *Enhance Social Equity, Environmental Justice, Community Health and Quality of Life* IC indicators (13.7%) under the environmental dimension focus mainly on Human rights & environmental justice (8.4%), particularly on indoor air and environmental quality. While those that promote access to neighbourhood resources encourage site selection on a mixed-use area, its proximity to basic and essential services, and availability of alternate transport infrastructure and facilities.

Among the SoP measures defined by Owens et al. (2013: 2) those that relate to light pollution reduction, tree-lined streets, landscaping, green roofs, and views were included under the environmental dimension (Table 6-5). However, these LEED indicators do not mention Sense of Place on the credit narrative. For example, a note was included in the Coding Manual in Appendix F for the *Light pollution reduction* credit, which is focused on the more technical aspects of specifying luminaires, while a more qualitative explanation of the importance of maintaining adequate light levels could be of benefit for LEED users to understand the ultimate goal targeted by this credit.

Enhance Social Equity, Environmental Justice, Community Health and Quality of Life Impact Category				
Tier 3: Owens et al. (2013) Components (Key indicators)	Sustainability Square:			
	Environmental	Social	Cultural	Economic
Sense of place	0.9%	0.5%	3.8%	0%
Affordable, equitable and resilient communities	0%	1.4%	0%*	0%*
Access to neighborhood resources	4.3%	0.2%	0.7%	0%
Human	8.4%	1.9%	0.3%	0%

rights & environmental justice				
Key: (0%*) Indicators included in compatible SAS, not on school SAS. (++) Additional goal proposed by author				
References: Three tier coding system based on the Sustainability Square (Ebert et al., 2011:21) and LEED Impact Categories (Owens et al. 2013).				

Table 6-6: *Social Equity* IC components. Indicates % of indicators under each sustainability pillar and Owens et al. (2013) component.

6.4. Proposed LEED Cultural Vitality Pilot Credit Categories and Indicators

While the Owens et al. (2013) document establishes sustainability goals as a starting point to develop LEED v4 indicators, the credits on the LEED guide are organized under the nine (9) categories shown on Figure 6-9. LEED Cultural Vitality indicators are proposed to become part of the full suite/catalogue of Pilot Credits under the Innovation category, that are available on the LEED Credit Library.

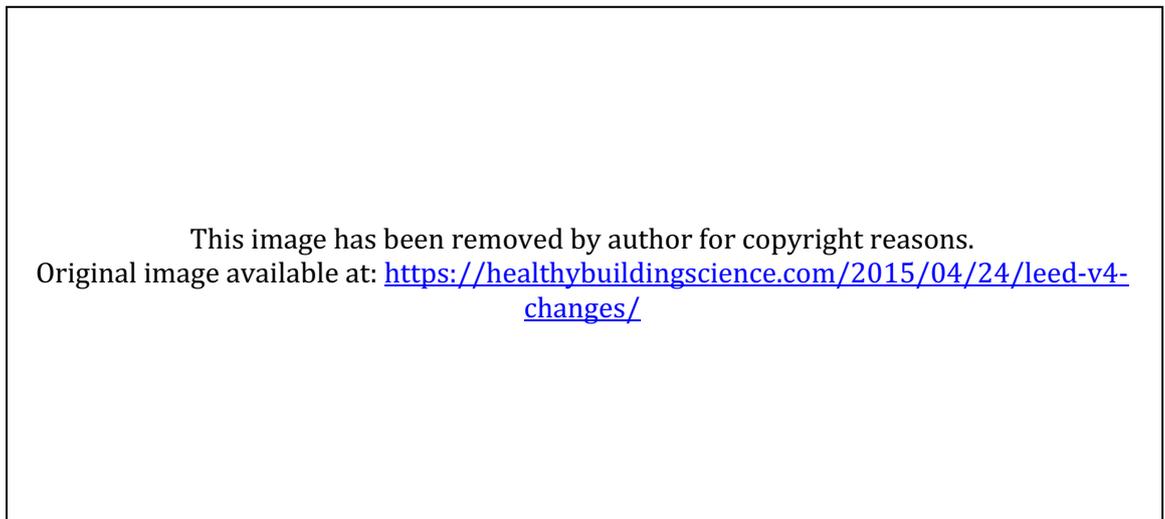


Figure 6-9: LEED v4 credit categories. Source: <https://healthybuildingscience.com/2015/04/24/leed-v4-changes/>

The following seven (7) cultural vitality categories were established in Chapter 3: Cultural Communication; Economy; Education; Governance, Heritage; Cultural Inclusion and Participation and Cultural Spaces (Figure 6-10). In order to determine LEED’s proposed Cultural Vitality categories, two aspects were taken into account: (1) labelling of existing indicators in SAS that target the cultural pillar (BREEAM, LEED, LBC, SB Tool, DGNB, Green Star, SBAT, SPeAR, RESET, IGL, Selo Casa Azul); (2)

literature review on cultural sustainability by several authors such as Walker (2014) and Axelsson, et al. (2013), that have developed cultural indicators and metrics to support design strategies and planning. Literature and indicators that promote cultural vitality in communities (Rosario Jackson et al., 2006; Zakariya and et al., 2016), which may also be applicable to schools, being a community in itself. Documentation from the United Nations Education, Scientific and Cultural Organization’s (UNESCO) proposal for Culture as the 4th Pillar of Sustainable Development in the Process of the Rio+20 Summit (Culture 21, 2011) and Culture for Development Indicators (United Nations, 2014) were also used as reference.

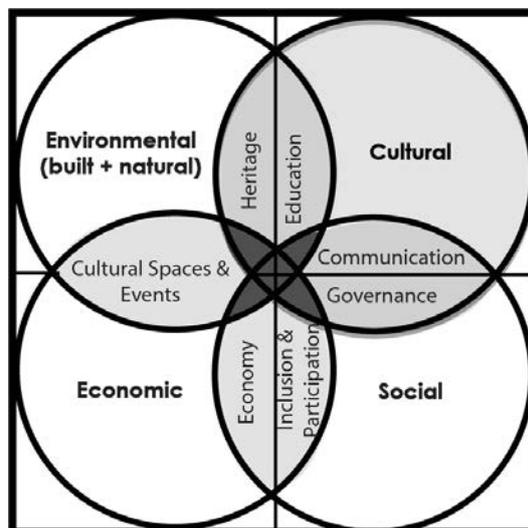


Figure 6-10: [Re]Categorization of Indicators in current SAS: Categories, Subcategories and Components. Diagram by author.

The next paragraphs will expand on and define the above-mentioned cultural sustainability components shown on Figure 6-10, as it may apply to the P.R. context:

- **Communication:** Indicators focus on freedom of expression, as well as the provision of internet access for cultural and creative content (Rosario Jackson et al., 2006; UNESCO, 2019; United Cities and Local Governments, 2008; United Nations, 2014). After the most recent emergencies or natural disasters that affected the Island, the role of schools as resource centres has become crucial, particularly for those students with limited resources. “Some students in Puerto Rico have lost access to educational systems as the [COVID-19] pandemic has led to another major disruption of educational continuity especially in areas most affected by the 2020 earthquakes. Lack of access to

smartphones, laptops, and Internet service has created challenges for distance learning and further exacerbated educational disparities” (National Center for Disaster Preparedness, 2020:18). Virtual communication has been critical on periods where schools have been closed or with limited access. Equipping schools, students and teachers with advanced technologies has been vital for maintaining instructional continuity.

- **Economy:** Considering that the tropical region has shown slower economic growth⁴⁶ than the temperate zone and that most countries in the tropics remain underdeveloped in the 21st century⁴⁷, culture can become an “enabler and driver of development”, as well as a source of economic and social progress (Rosario Jackson et al., 2006; UNESCO, 2019; United Cities and Local Governments, 2008; United Nations, 2014). Cultural and creative industries are one of the “most dynamic and rapidly expanding sectors” in the global economy⁴⁸, directly impacting tourism, one of P.R.’s main economic activities (Hernández-Acosta, 2017; Junta de Planificación, 2020; United Nations, 2014). Schools play an important role in the promotion and implementation of inclusive education in arts and culture, in addition to shaping students that will become future entrepreneurs, creative professionals or clients for cultural productions.

Cultural economy indicators in SAS worldwide focus on the contribution of cultural activities, industries, and employment to the economy; philanthropic expenditures in support of arts and cultures and academic integrity (respect

⁴⁶ Gross National Product (GNP) per capita in the tropical region was 25 percent of that in the temperate-zone in 1992. GNP growth per year for tropical regions was slower (0.9%), than in the temperate region, which showed a constant growth (GNP 1.4%) (Balls, n.d.).

⁴⁷ Only two tropical-zone countries namely, Hong Kong and Singapore, are ranked among the 30 countries classified as high-income by the World Bank. The remaining high-income regions are located outside the tropics (Balls, n.d.).

⁴⁸ The creative and cultural sector accounted for 3.4% of global GDP in 2007 (UNCTAD, 2008).

rights of authors and plagiarism avoidance) (Rosario Jackson et al., 2006; UNESCO, 2019; United Nations, 2014).

- **Education:** Indicators promote training in culture, including multilingual education, arts, and creative fields, as part of the curriculum and/or afterschool programs (Rosario Jackson et al., 2006; UNESCO, 2019; United Cities and Local Governments, 2008; United Nations, 2014; Wu et al., 2016). It is important to point out that during this research interviews, one of the participants commented on the importance of providing afterschool programs as a strategy to promote community integration and sense of belonging:

That was something that was discussed during the design process, about how you can integrate the community to the school. [...] The [...] school is urban and what we desired, and again I do not know if it is being done, is to open the school after regular hours. Typically, children leave after class and the school closes. That is unfortunate because then the community is not integrated into the school, the parents are not involved, which is a huge problem, that is endemic, it happens everywhere. There is no sense of belonging. [...] But what you want is that the building is more than a place where you go to a classroom, you go to class and then you leave. How is that accomplished? That is entirely programming [...] (IP-D1).

Recently, federally funded initiatives in P.R., have included the development of after school programs with a cultural focus, further reinforcing the relevance of indicators under this category (Guillama Capella, 2021).

- **Governance:** Cultural development requires appropriate governance structures to create and enforce policies to support culture and diversity, while encouraging social participation in related activities (UNESCO, 2019; United Cities and Local Governments, 2008; United Nations, 2014). These indicators promote the development and disclosure of policies about arts and culture, as well as participation of the school community in cultural governance to promote Sense of Place.
- **Heritage:** Indicators consider the impact of the proposed building on the existing context while aiming to protect the character of place and local

history through design and by employing local materials or techniques (Arup, 2012; IGLA, 2016; UIA, 2012; UNESCO, 2019; United Cities and Local Governments, 2008; United Nations, 2014; Wu et al., 2016). This category encourages the adaptive reuse of school buildings and raising awareness of its heritage value amongst the community and public (BRE Global-Intl., 2016; Green Building Council of Australia, 2015; iiSBE, 2009; USGBC, 2014b). Currently, local schools used as a teaching tool, focus on showcasing its environmental sustainable features but could also include cultural elements and symbols for teaching and learning.

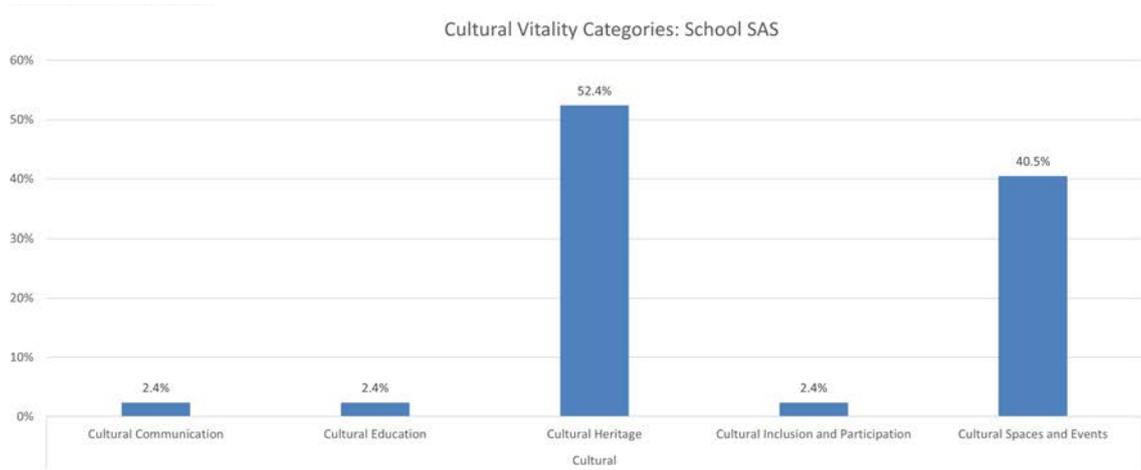
- **Inclusion and participation:** Promote art making practices, training programs, associations, volunteering opportunities and participation in cultural activities, with equal rights for both men and women (Rosario Jackson et al., 2006; UNESCO, 2019; United Cities and Local Governments, 2008; United Nations, 2014).
- **Spaces and events:** Includes indicators that promote the availability of spaces for cultural activities, social exchange, public art integration and recreation, as well as interaction with the environment (Arup, 2012; CSIR, 2015; DGNB System, 2022; “German Sustainable Building Council (DGNB),” 2014; IGLA, 2016; iiSBE, 2009; International Living Future Institute, 2019, 2014; Rosario Jackson et al., 2006; UIA, 2012; United Cities and Local Governments, 2008; USGBC, 2022d, 2022e; Wu et al., 2016). Also, promote the provision of spaces and learning environments that foster spirituality, creativity, and sense of place (International Living Future Institute, 2019, 2014; Wu et al., 2016). During the survey and interviews, architects emphasized on the inclusion of naturally ventilated spaces adequate for the local climate, such as open courtyards which served as a central organizing element for case study schools. These open spaces also provide opportunities for children socialization during recess time and a direct relationship with nature. This building configuration, echoes P.R. architectural tradition where the courtyard has been used since Spanish colonial architecture up to modernity.

Table 6-7 shows the alignment between the LEED *Social Equity* IC components (Owens et al. 2013) and the proposed Cultural Vitality categories. The “X” symbol indicates that cultural indicators were classified under the corresponding IC component and CV category. For example, indicators under the Cultural Spaces and events category target all four (4) *Social Equity* IC components or goals.

Cultural Dimension: Enhance Social Equity, Environmental Justice, Community Health and Quality of Life Impact Category							
Tier 3: Owens et al. (2013) Components (Key indicators)- Goals	Cultural Vitality Components						
	Communication	Economy	Education	Governance	Heritage	Inclusion & participation	Spaces & events
Access to neighbourhood resources	X						X
Affordable, equitable and resilient communities		X				X	X
Human rights & environmental justice	X		X		X	X	X
Sense of place				X	X		X
Key: X= Indicators were classified under the corresponding IC and category							
References: Sustainability Square (Ebert et al., 2011:21); LEED Impact Categories (Owens et al. 2013).							

Table 6-7: Alignment between the LEED Social Equity IC (Owens et al. 2013) and proposed Cultural Vitality Categories or Components

Figure 6-11 illustrates that most indicators in School SAS were classified under the Cultural Heritage and Cultural Spaces and Events category, given that these are linked to the built environment. In contrast, to CV categories that deal with programmatic or user related aspects such as Communication, Education and Inclusion and Participation. However, additional indicators found on Literature Review (Rosario Jackson et al., 2006; United Nations, 2014; United Cities and Local Governments, 2008) also include indicators dealing with cultural Economy and Governance, which may be added to future revisions of LEED and other systems.

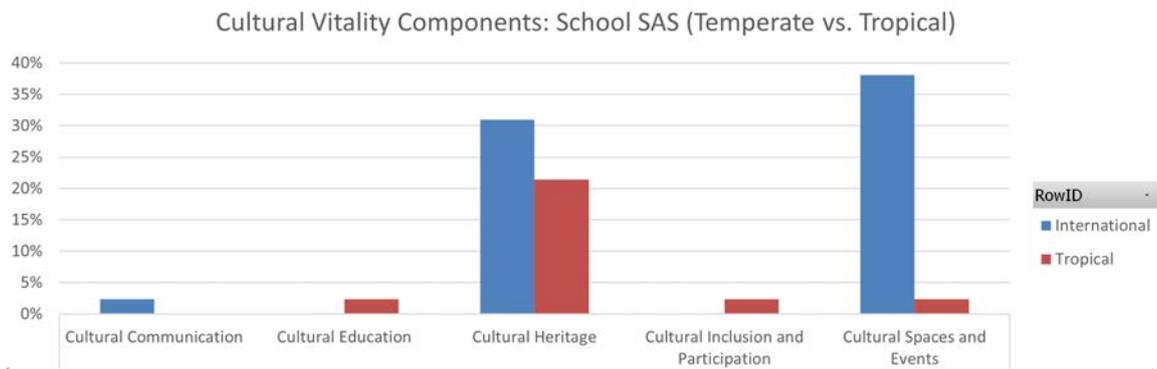


KEY- SAS INCLUDED IN THIS ANALYSIS:

SCHOOLS										COMPATIBLE SAS									
TEMPERATE					TROPICAL					TEMPERATE					TROPICAL & SUBTROPICAL				
LEED	BREEM	GREEN GL.	LBC	SB TOOL	GREEN M.	GRIHA P.	RESET	TERI G.		LEED ND	SPeAR	JUST	DGNB	CASA AZ.	PCES	ISLAND GL	G STAR-A	G STAR-SA	SBAT
X	X		X	X			X												

Figure 6-11: Cultural Vitality Categories: School SAS

As shown in Figure 6-12, cultural Education as well as Inclusion and Participation components were included in the RESET tropical SAS but not on the International SAS analysed. On the contrary, cultural Communication was only included in International SAS. This information sheds light on the priorities established by each region and missing components that could be further developed as indicators.



KEY- SAS INCLUDED IN THIS ANALYSIS:

SCHOOLS										COMPATIBLE SAS									
TEMPERATE					TROPICAL					TEMPERATE					TROPICAL & SUBTROPICAL				
LEED	BREEM	GREEN GL.	LBC	SB TOOL	GREEN M.	GRIHA P.	RESET	TERI G.		LEED ND	SPeAR	JUST	DGNB	CASA AZ.	PCES	ISLAND GL	G STAR-A	G STAR-SA	SBAT
X	X		X	X			X												

Figure 6-12: Cultural Vitality Components: School SAS (Temperate vs. tropical)

Indicators analysed were adapted for the school context, when necessary, while others that dealt with similar themes were combined and edited. A list of thirty-nine (39) cultural indicators was included on the survey to design and construction professionals, organized by CV components or categories, as shown Figure 6-13. Participants were asked to prioritize “how important it is that LEED includes the following indicators to assess sustainable schools in P.R.”. Appendix G shows the final indicator list that was included on the survey and identifies which credits are included on LEED or other SAS, as well as the references consulted.

31. Cultural indicators for schools in P.R.: Cultural Spaces and Events

Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

	Very Important	Important	Somewhat Important	Not important
Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 6-13: Extract from survey. Indicators on the Cultural Spaces and Events CV category.

It is important to remark that indicators selected by professionals as most important were those under the Cultural Heritage; Cultural Spaces and Events and Education categories. These categories are also targeted by RESET, which was the only tropical school SAS analysed that included cultural indicators (Figure 6-12). This further validates the research results to date, given the alignment between regional priorities in RESET and local priorities expressed on the survey.

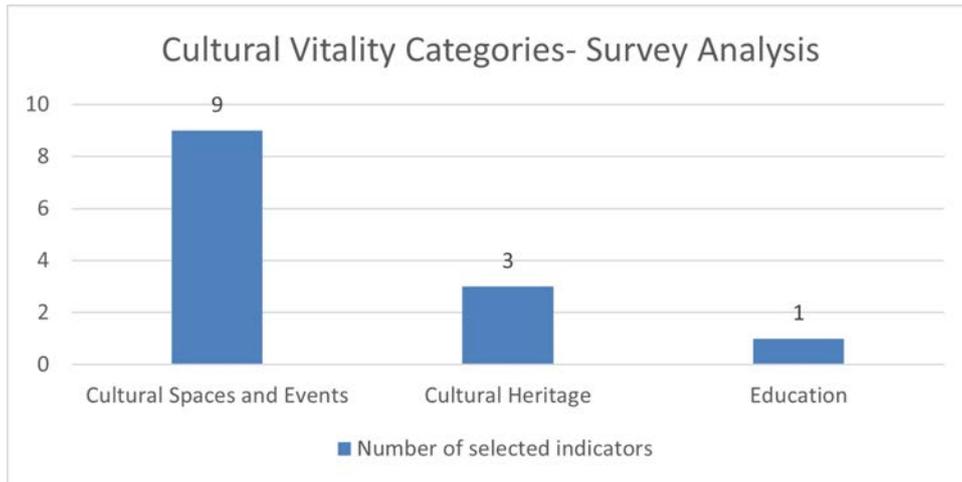


Figure 6-14: Cultural Vitality Categories and number of indicators selected as important on the survey to design and construction professionals.

Cultural Spaces and Events		Cultural Heritage	
Indicator	Indicator currently in LEED?	Indicator	Indicator currently in LEED?
31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	NO	29.1. Impact of the school design on existing streetscapes.	NO
31.3. The building has spaces for cultural activities.	NO	29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	LEED NEIGHBOURHOOD (ND)
31.4. Provide a space for communal meals	NO	29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	NO
31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.	LEED SCHOOLS		
31.6. Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.	LEED SCHOOLS		
31.9. The building makes people feel a sense of place, belongingness and rootedness.	NO		
31.11. Learning environments and school culture foster creativity and innovation.	NO		
31.13. Aesthetic quality of the building	NO		
31.14. Neighborhood Facilities: Availability and access to cultural related establishments or venues.	SIMILAR IN LEED NEIGHBOURHOOD (ND)		
		Education	
		Indicator	Indicator currently in LEED?
		28.4. Child involvement in afterschool arts and cultural programs	NO

Figure 6-15: Final list of indicators with categories based on survey analysis, to be further developed (n=13)

Figure 6-15 includes the final list of thirteen (13) indicators selected as important for the P.R. school context by design and construction professionals. The next chapter will present the analysis of the survey results and the quantitative study performed to select these credits. Moreover, selected indicators were further developed informed by Placemaking, a thematic analysis of strategies and metrics in similar indicators worldwide, and the input of local LEED Accredited professionals during a second-round of semi-structured interviews.

6.5 Conclusions

The [Re]categorization of Indicators in Sustainable Assessment Systems (SAS) worldwide confirmed that there are few SAS that address cultural elements as sustainability indicators (R01), which presents an opportunity to strengthen that sustainability pillar. Also, revealed possible cultural aspects of sustainability in the tropical Caribbean region that are excluded from LEED for Schools but could be incorporated as indicators (R03). The analysis of cultural strategies in SAS worldwide validates the approach initially presented in Chapter 3 that employs use of Pilot Credits in the Innovation in Design Category as a tool to test the new indicators proposed as part of this investigation.

In order to determine the final list of indicators, these were classified following a three-tier coding system based on the sustainability square ([Ebert et al., 2011:21](#)) and goals established in the Owens et al. (2013) LEED Impact Category (IC) and Point Allocation Process Document. The grouping of indicators allowed us to identify global trends and provide a definition for each sustainability pillar based on the goals currently being targeted by school SAS worldwide. A closer examination of the *Social Equity* IC allowed us to understand how the concept of Sense of Place is defined in LEED and aspects that should be strengthened.

This chapter further defined Cultural Vitality categories and explained the selection process for the thirty-nine (39) cultural indicators included on a survey to LEED design and construction professionals where participants prioritized cultural issues

for P.R. After quantitative analysis of the survey results, the number of indicators was reduced to thirteen (13) and further developed in collaboration with professionals using action research strategies, as will be further discussed on Chapter 7.

Chapter 7: Cultural Indicators and the Conceived Space

7.1. Introduction

As indicated in Chapter 6, this research pursued a mixed methods 4-phase data collection strategy, aligned with the research objectives. The current chapter will focus on the research findings from Phase 3, which included a survey and interviews for design and construction professionals of LEED certified case study schools. These research instruments served as tool to build a cultural profile of schools in P.R. in order to identify what aspects of sustainability in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators **(RO3)** (Figure 6-1).

Phase 3	<p>(a) Design and Construction Professionals Survey (n=23) Statistical analysis ▼</p> <p>(b) Semi-structured Architect Interviews (n=5) Thematic analysis ▼</p> <ul style="list-style-type: none"> •Cultural indicators for P.R. •Conceived space: <ul style="list-style-type: none"> •User perception: LEED certification process •Design intention: Cultural identity and expression •Building use: Placemaking strategies 	QUANT./QUAL.
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Figure 7-1: Phases 3 Research Techniques, section from the Methodological Framework (by author).

Section 7.2 will expand on the methods employed in phase 3, including case study selection, sampling strategy, recruitment procedure and research instruments, while 7.3 will present an overview of participant's profile. Sections 7.4 will discuss the Conceived Space Findings including:

- User perception: Professional experience with the LEED certification process as well as the analysis employed to select the preliminary list of cultural indicators to be further developed for the local context.
- Design intention and building use: Expands on cultural identity meaning by participants and its expression in building design and construction through architectural and placemaking strategies, particularly focusing on socio-cultural spaces. This section will present specific strategies employed in local

case study schools that could inform the development of proposed LEED indicators.

Finally, section 7.5 will present the conclusions from this chapter.

7.2. Methods: Case Study Selection, Sampling Strategy and Recruitment Procedure (Phase 3)

7.2.1. Case Study Selection

Out of 1,481 schools in P.R., 849 or 57.32% of PK-12⁴⁹ institutions, belong to the public school system, serving the majority of the local student population. The remaining student population attends private or church schools. This research has focused on ten (10) of these public schools, which were LEED certified during years 2013-2016. Even though public LEED certified green schools are a minority, comprising 1.18%, of the current education building stock in P.R., this research included all schools throughout the different research phases to ensure that the sample was sufficient to reach conclusions. However, Phase 3a, which included a survey for design and construction professionals, focused on **eight (8)** of these schools located on the main island, as illustrated on Figure 7-2. Two schools were excluded from this phase, one due to its location on an outlying island and another that was submitted as “confidential” and therefore invisible for the public in the LEED Project Directory which was used as reference to determine the schools to be investigated ([USGBC 2021](#)). To date, there are no private LEED certified schools in P.R.

⁴⁹ Based on the U.S. and P.R. educational system, which names school levels prior to college as Pre-kindergarten (PK) through the 12th grade (12). Includes preschool, elementary (primary) schools, middle schools, and high (secondary) schools (International Affairs Office, U.S. Department of Education, 2008).

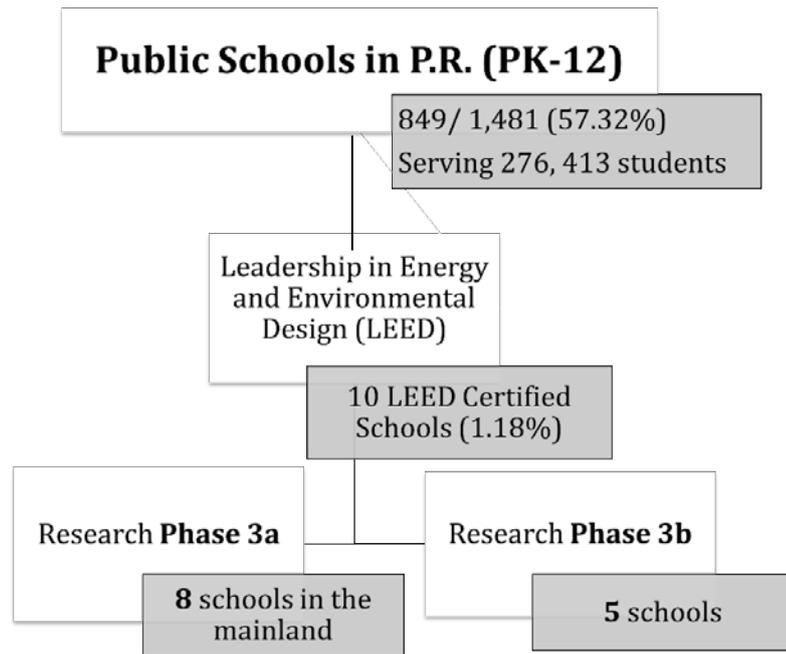


Figure 7-2: Schools in P.R. - Quick facts (IEPR, 2021; NCES, 2021; USGBC, 2022).

Five (5) case study schools were then chosen for in-depth analysis in Phase 3b. Cases were selected mainly based on the Department of Education of P.R. Educational Regions distribution. Regions I and II were selected because these are the ones with the highest number of LEED certified “new construction” projects (Figure 7-3). This allows for comparison between schools within the same region.

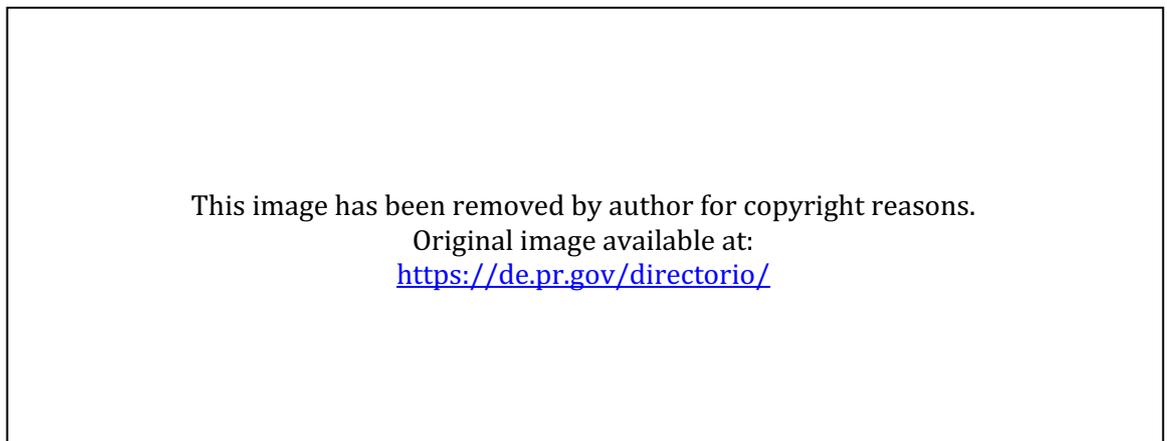


Figure 7-3: Educational Regions: P.R. Department of Education (DEPR, 2018). Original image edited by author. While regions are indicated in color, schools are identified with a letter. The name of each region is not indicated on the map for confidentiality reasons.

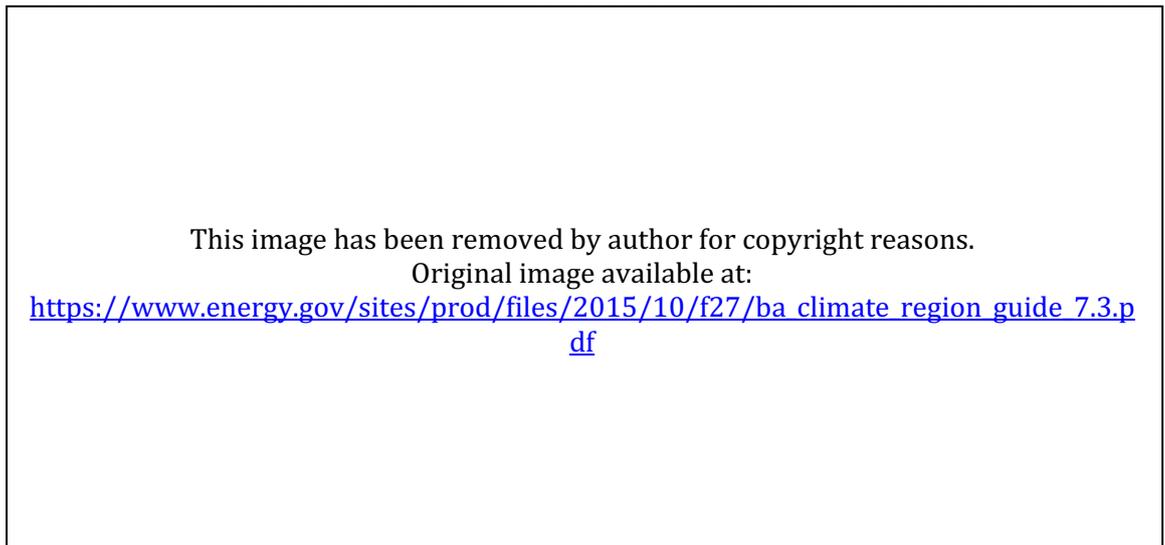


Figure 7-4: Climate Regions (U.S. Department of Energy, 2015)

The case study selection process also explored climatic differences within the school regions. In general, P.R. is classified under the Hot humid/ climate zone 1⁵⁰ that includes other territories such as Southern Florida, Hawaii, Guam and the Virgin Islands (Figure 7-4). This classification system is used by the International Energy Conservation Code (IECC), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and therefore LEED. However, P.R. is more hurricane prone, has a longer rainy season, hotter temperature and higher humidity levels than other comparable states in Climate Zone 1, such as Florida, due to its location closer to the Equator⁵¹ (Kaye, 2015). These climatic subtleties lead to different design strategies, construction materials and techniques that respond to the environmental reality of the Island, as will be discussed throughout this chapter.

A closer look at the Koppen Climate Classification map illustrates slight variations through the Island's four (4) climatic classifications (

⁵⁰ "A hot-humid climate is defined as a region that receives more than 20 inches (50 cm) of annual precipitation and where one or both of the following occur: A 67°F (19.5°C) or higher wet bulb temperature for 3,000 or more hours during the warmest six consecutive months of the year; or a 73°F (23°C) or higher wet bulb temperature for 1,500 or more hours during the warmest six consecutive months of the year" (U.S. Department of Energy, 2015).

⁵¹ P.R. average annual temperature in its capital San Juan is 31°C (87°F) with 78.3% humidity while in Miami it is (29°C) 84°F with 75.8% (Kaye, 2015).

Figure 7-5). This research will focus on the Rainforest climate division, where the selected five (5) case study schools are located. This region has a relatively humid climate, in contrast to southern parts that are more arid. The Cordillera Central and Sierra de Cayey central mountains that run from east-west, as well as local wind patterns, affect the site's amount of rainfall and average temperature (Figure 7-6). Selected schools are located in municipalities on the windward side of the mountains and receive higher rainfall amounts than those on the leeward side (USGS, 2016). Schools located on the interior mountainous areas in a higher elevation present lower annual air temperature ranges from 25- 22 degrees Celsius (C) (Schools C, D) than those in lower elevation or coastal areas, with a mean of 27- 24 °C (Schools A,B,E) (USGS, 2016). Cooler temperatures provide for a more pleasant climate to perform outdoor activities, particularly during midday when students get their recess time.

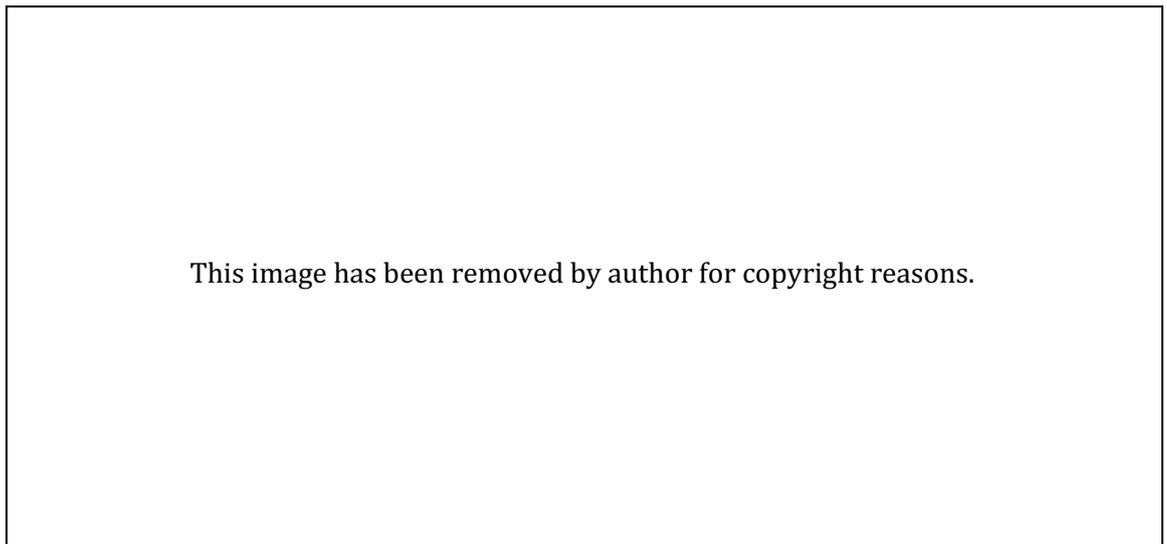


Figure 7-5: Map of green schools using the Koppen Climate Classification system. Original map by Pedal Chile (2021) modified by author to include school location.



Figure 7-6: P.R. Topography Map. Illustrates the central mountainous region that crosses the Island from East to West. Schools are located on the northern side of the Island, with schools C and D presenting the highest elevation. Image by Free World Maps (2021) modified by author to include school location.

Appendix H summarizes the main characteristics of the ten (10) LEED certified schools in P.R. However, in this section we will focus on the five (5) LEED certified PK-12 public schools in Regions I and II (2013-16) chosen for in-depth analysis, as shown in Table 7-1. One (1) of these schools was certified under the LEED Building Design and Construction (BD+C) version 2.2 (school D), while the remaining four (4) employed the updated version 3. The latter were part of the extended federally funded programme Schools for the 21st Century (2010-16)⁵². Schools B and C obtained LEED silver while A, D and E achieved the gold certification level. School buildings range between 6689.02-10814.10 sq. m. (72,000- 116,402 sq. ft.) and serve between 356- 653 students (NCES, 2021; USGBC, 2016a). Three (3) cases are located in a rural context and two (2) on urban areas, while four (4) offer traditional education and one (1) is vocational. This varied sample, illustrated on Table 7-1, allowed the researcher to identify similarities and/or differences between these green schools based on its climate, context, educational offerings, LEED version or certification level. The strategies employed in the design and construction of these schools will inform the development of LEED credits adapted for local conditions.

⁵² The Schools for the 21st Century project was introduced by the administration of Governor Luis Fortuño from the Progressive Party and ran from 2010-12. An extended program named Schools First (2013-2016), was introduced by Governor Alejandro García Padilla from the Popular Democratic Party after a change in political administration in the 2012 elections.

ID	Context		LEED Version (BD+C Schools)		LEED Cert. Level (Points Achieved/Max.)		Year Certified (2000's)				Educ. type		Sq. Ft.	No. of students
	Rural	Urban	v2.2	v3	Silver	Gold	13	14	15	16	Trad.	Voc.		
A	X			X		64/110		X			X		116,402	547
B		X		X	53/110		X				X		71,880	356
C		X		X	54/110			X			X		143,860	653
D	X			X		63/110				X		X	89,149	424
E	X		X			39/69		X			X		72,000	542

Table 7-1: LEED Schools: Case Study Selection Matrix (NCES, 2021; USGBC, 2016a).

7.2.2. Sampling Strategy and Recruitment Procedure

Phase 3 included a survey and semi-structured interviews to design and construction professionals. The recruitment strategy, research instruments and informed consent forms were approved by both the University of Puerto Rico- Carolina and Nottingham Trent University Ethics Committees (Appendix I). Also, the survey was reviewed and discussed with five (5) professionals with an architecture, education and/or statistics background for their feedback before administering it to the target population.

This research employed a generic purposive sampling strategy in reference to the goals of the research (Bryman, 2012:418). The criteria for selecting the target group was determined a priori and the list of participants was generated performing an internet search using the name of each of the eight (8) LEED certified case study schools in P.R.'s mainland, as listed on LEED's Project Directory (USGBC, 2020b). This retrieved links to newspaper clippings, documents and webpages of architectural firms, engineers and sustainability consultants who worked on the design and construction of these schools and their contact information. The list of professionals was confirmed with the school architects either by telephone or during the interview process. Even though snowball sampling was not an initial strategy of this research,

some architects referred additional professionals on the school design and construction team. Twenty-three (23) out of thirty (30) participants completed the survey for a 76% completion rate, exceeding expectations.

Professionals (architects, engineers, and sustainability consultants) were initially contacted by telephone. In this conversation, the research investigator briefly explained the research project, verified their email address, and asked them if an electronic questionnaire could be sent to them. It should be noted that, in order to access the electronic questionnaire on the Jisc Online Survey platform, they had to read the Informed Consent Form first, select the option that indicated they “agree to participate in the study” and press submit. If they selected the option that stated that they “do not agree to participate”, they would automatically exit the survey. The Consent Form included the principal investigator’s contact information in case they had any questions or concerns. Five (5) to seven (7) days, after the initial contact, a reminder message was sent to the participants who had not yet answered the questionnaire to increase the response rate.

After participants answered the questionnaire, the selected architects of the five (5) case study schools in DEPR Regions I and II were contacted again by telephone or email to coordinate the individual interviews and explain their participation, if a meeting date was not determined on initial contact. Prior to the meeting, the principal investigator sent the Informed Consent Form and the interview questions by email to the participants so that they could review the documents beforehand. Before beginning the interview, the Informed Consent Form was discussed with the participants and any questions they had were answered before they signed the document. Architects from all five (5) case study schools participated in this 1st round of interviews, achieving a 100% completion rate.

7.2.3. Research Instruments: Online Survey and Interviews to Green Building Professionals

Following the Subjective Ontology and the Interpretivist epistemologies, this investigation explored the **Design intention** or **subjective construction of**

meaning by design and construction professionals through the online survey and interviews. Both Phenomenology and Semiology theories guided the development of these research instruments. While both philosophies are concerned with the production of meaning, the first prioritizes user's lived experience while the latter focuses on how individuals produce meaning (Chang, 1987). In line with similar studies that have employed both theories to analyse the modern life-world (Chang, 1987), this research referenced **Phenomenology** to explore participant's experience in the design and construction of their schools. According to Norberg Schulz, man-made places are related to nature in three (3) ways: (1) visualization, which allows man to understand the nature of the site and design his intervention based on his previous experiences and culture; (2) man complements what is lacking on the site by adding the necessary elements and (3) finally through symbolization, he portrays his understanding of nature (1980: 17). Following these theories, this research explored participant's cultural identity meaning, influences and experiences that informed the building's cultural expression. Furthermore, specific architectural and Placemaking strategies were also studied to evaluate their possible inclusion on proposed LEED indicators. Moreover, **Semiology** theories were applied to investigate how the designers' cultural background informed local school buildings' structure and space organization (Parsaee et al., 2015).

The survey instrument included seven (7) main sections, as shown in Figure 7-7. First, the Consent Form introduced the aims of the study and described a target population of approximately thirty (30) design and construction professionals from the eight (8) LEED certified schools in the mainland. Also, explained that participation is voluntary and does not involve any risks other than those encountered in daily life. Clarified that participants will not receive any direct benefit, beyond the satisfaction of having contributed to the improvement of the assessment tool for sustainable buildings in Puerto Rico. Furthermore, described confidentiality procedures for handling personal information stating that a code will be used to discuss individual results. The following section 2, Demographic and general questions, asked participants about their age, gender, ethnicity and years of professional experience. Based on their answers to the demographic and general

questions, particularly their role in the school design and construction process, participants were directed to specific sections on the survey. For example, section 3 focused on Culture and Placemaking to understand architect’s definition of P.R.’s identity and design intention; including architectural strategies employed in schools. Sections 4-5, target both architects and sustainability consultants to investigate which cultural symbols and Placemaking strategies were employed by professionals in case study schools. Sections 6-7 were available for all professionals, including engineers, to measure user perception, including the level of satisfaction with LEED and adequacy to measure sustainability in P.R. Appendix J includes an extended version of the diagram below, including a sample of the survey questions under each section.

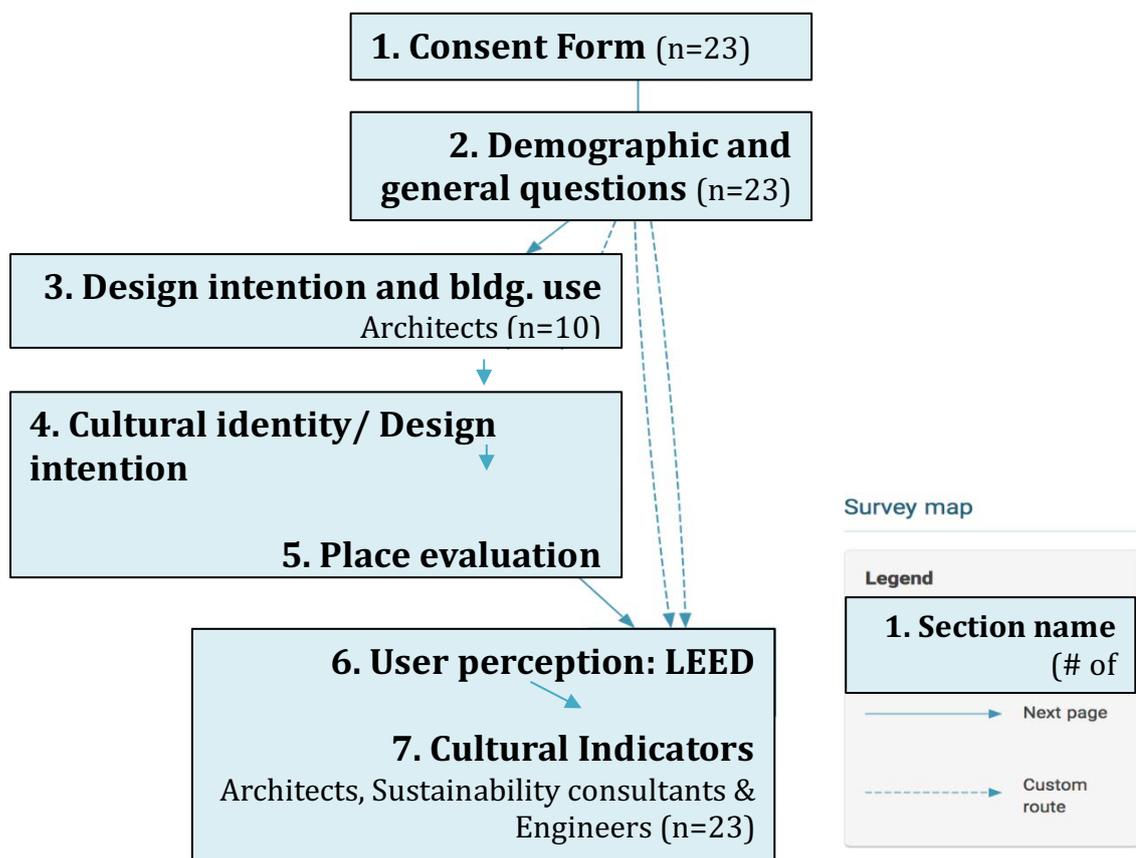


Figure 7-7: Survey map: Includes section name, number of professionals that answered each set of questions.

While Appendix K includes the survey consent form and research instrument, Appendix L contains the interview questions designed for participants to expand on

survey responses and give concrete examples of their school projects. Both research instruments were aligned with the research aims as shown in the methodology matrix table on Appendix D. It is important to point out that interviews were performed in Spanish, which is the participants' and main researcher first language. Interviewee quotes were later translated by the main researcher, which is also fluent in English. The role of researcher/ translator offered the opportunity to place close attention to cross cultural meanings and interpretations, bringing the researcher up close to the problems of meaning equivalence within the process (Temple and Young, 2004:168).

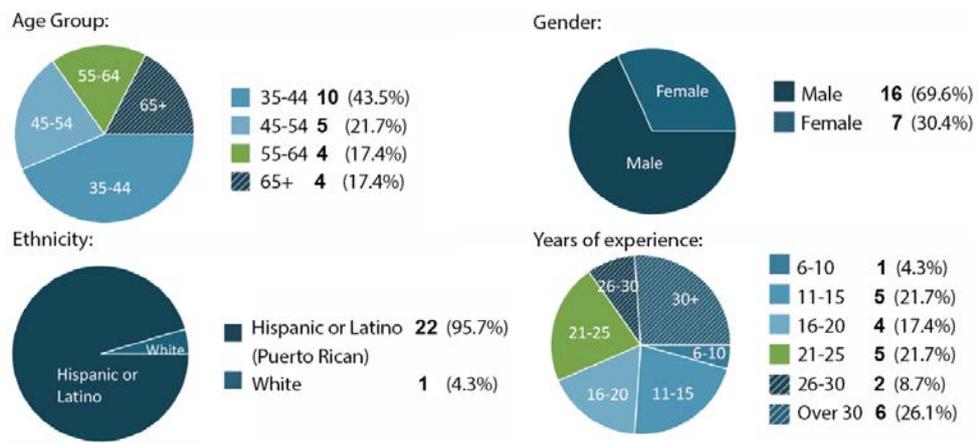
This study employed mixed methods techniques, including statistical analysis for quantitative data using both Excel and the Statistical Package for Social Sciences (SPSS) software, as well as qualitative thematic analysis aided by the NVivo program. The latter followed Watts (2014) methodology which entails coding or identifying relevant themes and supporting quotes within the interview transcripts to understand data from the participant's perspective. This inspired the development of framework matrices for the interview and survey open-ended questions, which aided the analytical process. A sample of the thematic analysis is included in Appendix Q. The next sections will examine participant's profile and responses to survey and interview questions, which were designed to investigate meaning and meaning making of P.R.'s cultural identity.

7.3. Participant Profile

The data collection process was carried out between February and December 2020. Surveys were completed by twenty-three (23) design and construction professionals whose age ranged from 35 to 65+ years, the majority being 35-44 years old (43.5%). Most were male (69.6%), Hispanic or Latino (95.7%) and had over 30 years of experience (26.1%) in their respective professional field (Figure 7-8). The majority were architects (65.2%), although there was representation from other members of the design and construction team such as engineers and sustainability consultants.

As shown in Figure 7-8, eleven (11) survey participants (47.8%) are LEED accredited ⁵³ professionals while twelve (12) or 52.2% are non-accredited, presenting only a small difference in the number of respondents from both groups. The survey analysis revealed that most accredited professionals are young adults from 35-44 years old, comprising an 80% of participants in that age group (Appendix M).⁵⁴ It is important to point out that some professionals participated in more than one school but were asked to select one and answer the survey based on its qualities. However, on the interviews they were able to discuss and respond the questions based on their experience in all the schools they designed.

Survey: Demographic Questions (n=23)



⁵³ For the purpose of this research, this number includes both LEED Accredited Professionals (AP) and LEED Green Associates (GA). The latter can become AP's after approving an additional exam.

⁵⁴ To determine the relationship between age groups (35-44; 45-54; 55-64; 65+) and LEED accredited professionals, this research employed the Fishers Exact Test for independence using the SPSS software which generated an Exact Significance value of 0.028, less than 0.05 (Corder, 2009: 181). This means that there is a significant difference between certification status and age groups because most certified professionals are young adults, 35-44 years old. An 80% of participants in this age group are certified. This test is useful for analysing data resulting from small independent samples (Corder, 2009), such as this research project. Furthermore, we determined the measure of association between the two variables by calculating the phi coefficient (Corder, 2009: 169), which generated a value of 0.618. According to Cohen (1988), a number greater than 0.50 represents a large association between the different groups, further validating the Fisher's Exact Test results.

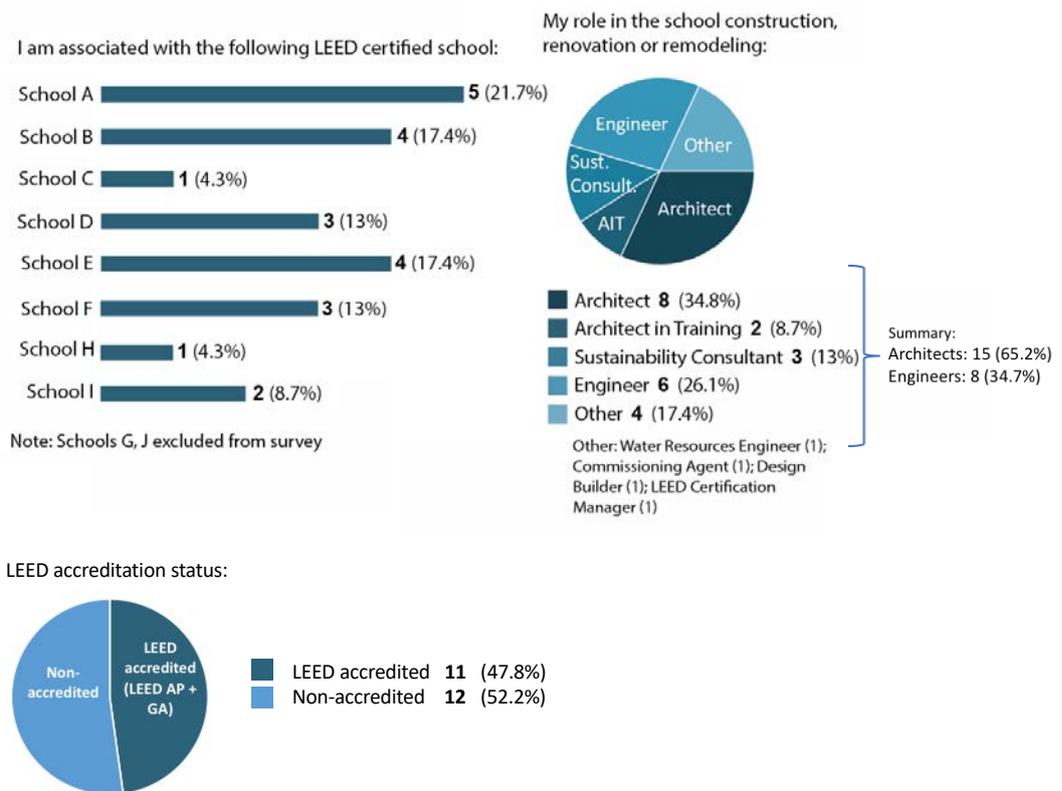


Figure 7-8: Design and construction professionals survey- Participant profile (n=23)

The first round of interviews was carried out with five (5) licensed architects, one for each of the selected case study schools. All of whom previously had completed the survey. 100% of participants occupying leading roles on the architectural firms were male. The majority were 65+ years old (60%), Hispanic or Latino (80%) and have over 30 years of experience (80%). These professionals are not LEED certified but are familiar with the system (Figure 7-9).

For confidentiality reasons, each school was randomly assigned a capital letter. Throughout this investigation, Questionnaire Participants (QP) or Interview participants (IP) will be identified with the letter that represents the school name and a number next to it. For example, the code IP-A2, will be used when quoting the Interview Participant from School A, identified as number 2.

Interviews: Participant Profile (n=5)

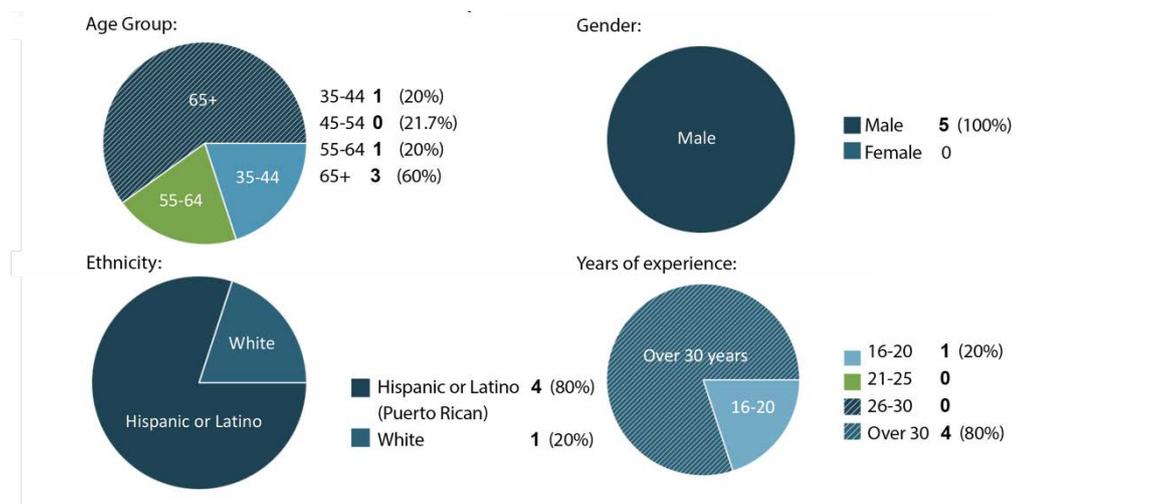


Figure 7-9: 1st round of Interviews- Architect/ participant profile (n=5)

7.4. Conceived Space

This section was organized following the Conceived Space Findings and Discussion diagram originally presented in Chapter 5 and included in Figure 7-10 as reference. First, section 7.4.1 will discuss “user perception” and professional experience with the LEED certification process, as well as the analysis employed to justify the preliminary list of cultural indicators to be further developed for the local context. The following section 7.4.2 will continue the conceived space discussion by focusing on “Design intention and building use”. It will expand on cultural identity meaning by participants and its expression through architectural and placemaking strategies. Also, present the analysis of case study schools that informed the development of proposed LEED indicators and revision of existing ones.

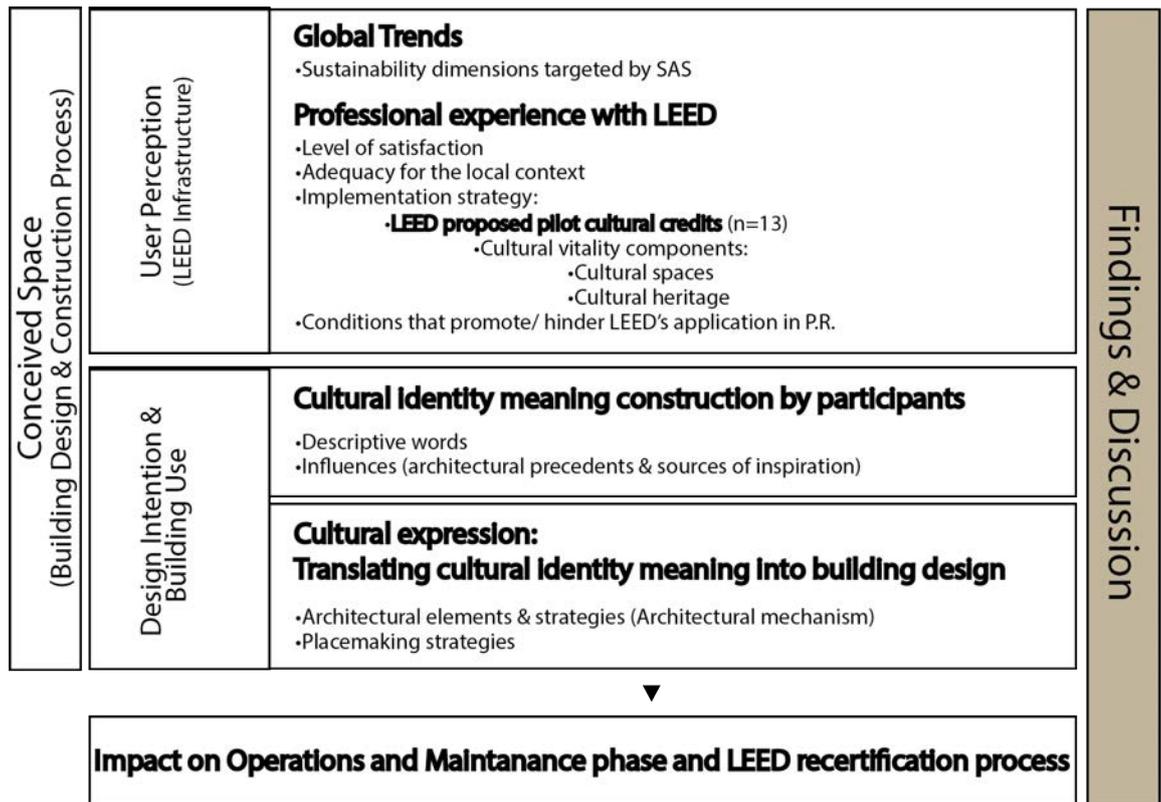


Figure 7-10: Conceived Space- Findings and Discussion diagram used as reference for this chapter's organization structure (by author).

7.4.1. User Perception: LEED Infrastructure

On Chapter 5, we discussed the concept of LEED as “infrastructure”. This term, defined by Easterling (2016:9), comprises the “standards and ideas that control everything from technical objects to management styles”, also the rules that promote the development of reproducible and generic buildings. This concept is also relevant to better understand Lefebvre’s conceived space, which is constituted by the intersection of knowledge and power, in which infrastructures are located. In his view, it pertains to those who wish to control the social organization and the space of everyday life (political rulers, economic interests, planners) (Pierce and Martin, 2015:1293).

In this case, survey instruments inquired about strategies professionals used to resist or challenge the LEED infrastructure while complying with the certification requirements. Also, discussed user perception and the participant’s professional experience with the LEED certification process of their school. Topics included, but

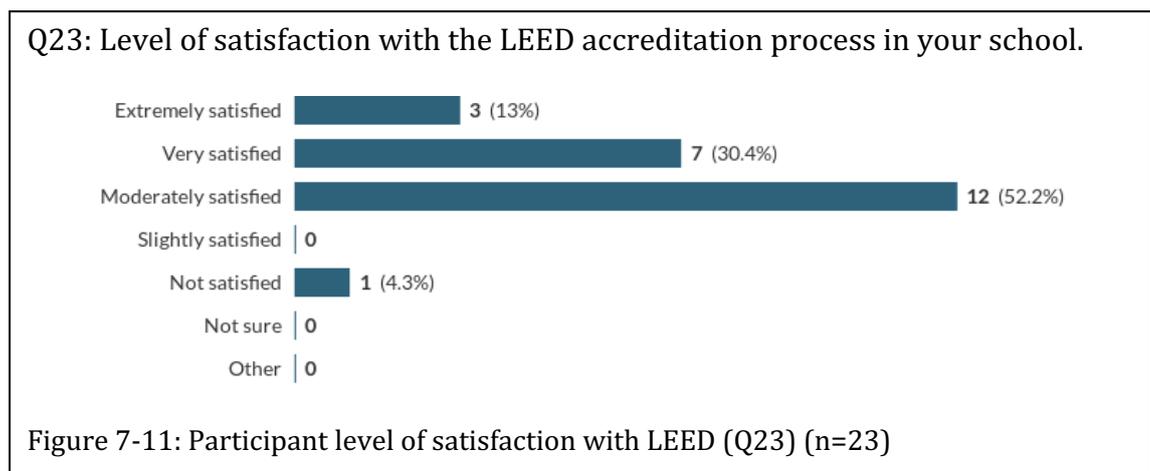
were not limited to, their level of satisfaction and adequacy of LEED to measure sustainability in the local context. Also, participants were able to select between a list of cultural indicators those they deemed relevant for the local context.

7.4.1.1. Professional experience with LEED

Participants level of satisfaction with the LEED certification process of their schools varied. As shown in Figure 7-11, 13% of survey participants were extremely satisfied, 30.4% very satisfied; 52.2% were moderately satisfied and 4.3% not satisfied. Respondents that were satisfied (extremely + moderately satisfied) with the LEED certification process of their schools commented:

We were able to achieve a higher certification than what was proposed and required within the same budget. In addition, all sustainable measures taken were to be used as a tool in the vocational curriculum of the school (QP-I1).

While another views the process as cumbersome but recognizes that the results are worth it (QP-D2).



Most moderately satisfied participants comments were specific about the Schools for the 21st century project requirements. For example, QP-B3 stated that the DEPR did not understand the potential of the LEED certification even though it was a requirement. Also, due to the project's tight budget and the Design Build delivery method used, several compromises in the desired sustainability goals had to be made (QP-D1).

Both moderately and not satisfied professionals critiqued the bureaucracy of the LEED documentation and commissioning processes (QP-A2,B3,D2). QP-D2 commented that both procedures are expensive and would rather spend that money in making the building more sustainable. Furthermore, several participants indicated that LEED requirements are inflexible with hot and humid climate realities while disincentivizing the use of natural ventilation and other passive design strategies (QP-A2,B4,C1,E1,E2,E4,H1). This was also one of the main reasons participants indicated on the survey that they believe LEED is not an adequate tool for measuring sustainability in Puerto Rico (Q26). As we will further discuss on the next section 7.4.2, passive design strategies were widely employed in local schools and became part of P.R. cultural expression, which is why this research identifies the need to further integrate these into LEED.

Figure 7-12 illustrates that while most professionals (47.8%) responded that LEED is not adequate for the local context, 26.1% believe it is. Further analysis using the Fisher's Exact Test resulted in a value of 0.022, less than 0.05, pointing to a significant difference between answers from LEED accredited and non-accredited professionals. While seven (7) out of the eight (8) questions discussed on this section 7.4.1.1 were analyzed using this test parameters, only Q26 resulted in a significant difference between responses from these professionals.

Results were further validated with the Cramer's V test value (0.629), which indicated a significant association between responses (Cohen 1988).⁵⁵ This shows that most non-accredited professionals (75%) believe that LEED is not an adequate tool for measuring sustainability in P.R., while only 18.2% accredited professionals (45.5%) believe the same (Table 7-3). A similar tendency is observed in 45.5% of accredited professionals that deem LEED an adequate tool but only 8.3% of non-accredited professionals agree. Survey analysis revealed that professional's LEED Accreditation status was tied to their perception of adequacy for the local context.

⁵⁵ The Cramer's V Test is used to measure the strength of the association resulting in a scale value from 0-1, indicating no association to complete association, respectively (Cohen 1988).

One could hypothesize that accredited respondents are more familiarized with the system than those non-accredited which, in turn, impacts participants responses.

Q26: Do you think LEED is an adequate tool for measuring sustainability in Puerto Rico? (Please explain)

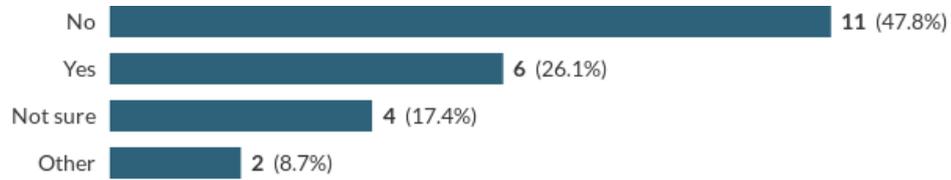


Figure 7-12: Adequacy of LEED for measuring sustainability in the local context (n=23)

	Value	Exact Sig. (2-sided)
Fisher's Exact Test	8.570	.022
Cramer's V	.629	.017
N of Valid Cases	23	

Table 7-2: Fisher's Exact Test & Cramer's V. The resulting value of 0.022, which is less than 0.05, points to a significant difference between responses from LEED accredited and non-accredited professionals. The Cramer's V test value of 0.629 indicates a large association (Cohen 1988).

Adequacy for measuring sustainability in P.R. vs. professional's LEED certification status crosstabulation (Q26)

			Professional's Certification Status		Total
			LEED accredited	Non-accredited	
Adequacy	no	Count	2	9	11
		Expected Count	5.3	5.7	11.0
		% within Cert	18.2%	75.0%	47.8%
	not sure	Count	2	2	4
		Expected Count	1.9	2.1	4.0
		% within Cert	18.2%	16.7%	17.4%
	other	Count	2	0	2
		Expected Count	1.0	1.0	2.0
		% within Cert	18.2%	0.0%	8.7%
	yes	Count	5	1	6
		Expected Count	2.9	3.1	6.0
		% within Cert	45.5%	8.3%	26.1%
Total	Count	11	12	23	
	Expected Count	11.0	12.0	23.0	
	% within Cert	100.0%	100.0%	100.0%	

Table 7-3: Adequacy for measuring sustainability in P.R. Most non-accredited professionals (75%) believe that LEED is not an adequate tool, while only 18.2% accredited professionals (45.5%) believe the same. 45.5% of accredited professionals deem LEED an adequate tool but only 8.3% of non-accredited professionals agree.

Q25: Do you think LEED targets the following sustainability dimensions?

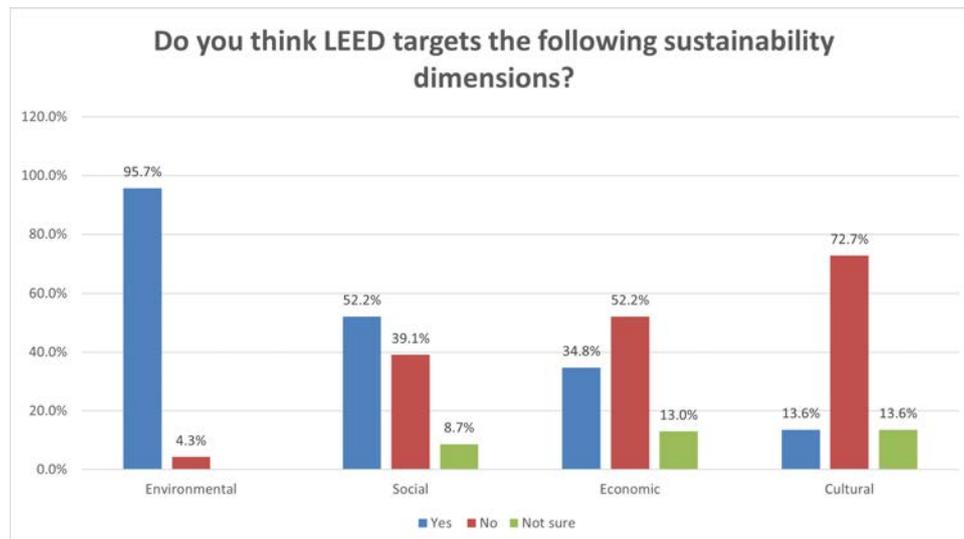


Figure 7-13: Do you think LEED targets the environmental, social, economic and cultural sustainability dimensions? (Q25). (n=23 architects, sustainability consultants and engineers of case study schools. Note: One participant left a blank response under the cultural dimension.)

In the online survey (Díaz, 2020), design and construction professionals were also asked to indicate their opinion on which sustainability dimensions are targeted by LEED (Q25). Most believe it targets Environmental issues (95.7%), a 52.2% Social, a 34.8% Economic and only a 13.6% believes it targets Cultural issues, as illustrated in Figure 7-13. User perception is in line with results of the International Comparison of Indicators presented on the previous chapter in which school SAS indicators mainly target the environmental dimension (Figure 6-4).

The analysis presented in Figure 2-5 (Chapter 2) of LEED versions 3, 4 and 4.1, further demonstrates this trend where the majority of indicators deal with environmental issues, particularly focusing in Energy and Atmosphere. This demonstrates the need to further look at the possible implementation of credits in other categories to strengthen LEED's whole sustainability approach, particularly on the cultural dimension which is the focus of this research.

7.4.1.2. Preliminary list of pilot cultural credits for P.R.

To identify what aspects of sustainability in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators [RO.3], we asked survey respondents to prioritize and select between thirty-nine (39) indicators based on the relative importance for cultural vitality in the P.R. school context. The list included indicators under the following seven (7) categories: Cultural Communication; Economy; Education; Governance, Heritage; Cultural Inclusion and Participation and Cultural Spaces. We performed the following four (4) quantitative analysis to participant responses in order to select the final list of indicators that will be further developed during this research:

Analysis #1: Chronbach's Alpha

The Cronbach's Alpha test was carried out to confirm the internal consistency or reliability of the survey Likert Scale questions #27-31 where participants indicated the relative importance of cultural indicators for the local school context. The reliability test was run in SPSS for all seven (7) cultural vitality categories or constructs. The Cronbach Alpha analysis resulted in a range from 0.809-0.963, as shown in Table 7-4. According to several authors, an alpha value of 0.70- 0.90⁵⁶ reflects that the scale is coherent and reliable (Fraenkel et al., 2012: 157; Lavrakas, 2008; Mohamad and et al., 2015:165), which is the case of items under the cultural governance and cultural heritage categories.

If the alpha approaches its maximum value (1.00), the indicators under each cultural vitality category may be correlated with each other. It may also mean that any one of the indicators would measure the construct as well as any other (Lavrakas, 2008). This might be observed in categories such as cultural communication, economy, education, inclusion & participation, as well as spaces & events which indicate values higher than 0.90. If the survey should be administered for a second time to school users (directors and teachers), as further research, we would evaluate whether some

⁵⁶ Cronbach's Alpha values range between 0 and 1.

of the indicators might be eliminated or combined. Another alternative would be to only include the indicators selected by professionals as most important to lower the alpha value and further validate the survey results by comparing professionals and school user responses.

Reliability (Cronbach Alpha) & Scale Statistics per Construct						
Cultural Vitality Category	Reliability Statistics		Scale Statistics			
	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Mean	Variance	Std. Deviation	No. of Items
27a. Cultural Comm.	0.935	0.935	6.61	4.067	2.017	2
27b. Cultural Economy	0.963	0.963	12.83	15.514	3.939	4
28a. Cultural Education	0.931	0.931	13.22	14.360	3.789	4
28b. Cultural Governance	0.809	0.808	9.26	7.020	2.649	3
29. Cultural Heritage*	0.842	0.835	19.68	12.894	3.591	6
30. Cultural Inclusion and Participation	0.961	0.961	18.48	35.806	5.984	6
31. Cultural Spaces and Events	0.911	0.912	47.78	57.451	7.580	14

Notes: *Excluded 1 participant response left blank. Total number of items= 39

Table 7-4: Reliability (Cronbach Alpha) and Scale Statistics per Cultural Vitality Categories. Cronbach Alpha values from 0.70- 0.90 indicate that the scale is coherent and reliable. Cultural vitality categories with values higher than 0.90, could be evaluated as further research, to determine whether some of the indicators might be eliminated or combined. Also, the test could be run only with the indicators selected by design and construction professionals to determine variations in the alpha values.

Analysis #2: We assigned ordinal values to the 4-point Likert scale categories used on the survey to calculate the mean. *Very important*, was assigned the maximum value of 4, while *not important* was given a value of 1. Based on similar studies (Green, 1982; Myllyviita and et al, 2013), indicators with a mean of 3.25 or higher would be considered important, yielding a list of 20 indicators, as shown in Appendix N.

Analysis #3: Based on comparable studies (Green, 1982; Naughton and et.al, 2017; Walsh and et.al., n.d.), a third analysis was performed by recategorizing the Likert scale categories *Very Important + Important* into YES and *Somewhat Important + Not Important* into NO. All twenty (20) indicators were marked as important by at least 70% of professionals (Appendix O).

Analysis #4: We applied Tastle & Wierman's (2007) formula to determine **consensus** among expert participants:

$$\text{Cns}(X) = 1 + \sum_{i=1}^n p_i \log_2 \left(1 - \frac{|X_i - \mu_X|}{d_X} \right)$$

where μ_X is the mean of X and d_X is the width of X , $d_X = X_{max} - X_{min}$ and X_i is the ordinal value assigned to each Likert Scale category.

If experts are in complete agreement, the resulting value would be a number close to 1, while complete disagreement would return a value near 0. Out of twenty (20) indicators, we selected those that resulted in a value of 0.5 or more, which means that at least 50% of participants agreed the indicator was important (Appendix P). **A total of thirteen (13) indicators comply, four (4) indicators already in LEED to be revised and nine (9) new indicators to be developed as Pilot Credits.** Figure 6-15 includes the final list of thirteen (13) indicators selected as important for the P.R. school context by design and construction professionals on the survey.

These indicators will be further developed considering the analysis resulting from the survey and 1st round of interviews questions (Phase 3) that inquired about the conceived space, particularly the styles, influences, and aspects from the participant's cultural background that were influential for the school design. Also, architectural elements and Placemaking strategies implemented in case study schools that could be used as reference to revise and develop new LEED credits suitable for the local context.

Cultural Spaces and Events	
Indicator	Indicator currently in LEED?
31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	NO
31.3. The building has spaces for cultural activities.	NO
31.4. Provide a space for communal meals	NO
31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.	LEED SCHOOLS
31.6. Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.	LEED SCHOOLS
31.9. The building makes people feel a sense of place, belongingness and rootedness.	NO
31.11. Learning environments and school culture foster creativity and innovation.	NO
31.13. Aesthetic quality of the building	NO
31.14. Neighborhood Facilities: Availability and access to cultural related establishments or venues.	SIMILAR IN LEED NEIGHBOURHOOD (ND)

Cultural Heritage	
Indicator	Indicator currently in LEED?
29.1. Impact of the school design on existing streetscapes.	NO
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	LEED NEIGHBOURHOOD (ND)
29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	NO

Education	
Indicator	Indicator currently in LEED?
28.4. Child involvement in afterschool arts and cultural programs	NO

Figure 7-14: Final list of indicators to be further developed in this research based on survey analysis (n=13)

7.4.2. Conceived Space: Design Intention and Building Use

The next sections will analyse the conceived space through a mixed methods analysis of the survey, complemented with interview responses. The discussion on design intention and building use will focus on cultural identity meaning construction by participants and its cultural expression in building design, framed by Phenomenology and Semiology supporting theories (Figure 7-15).

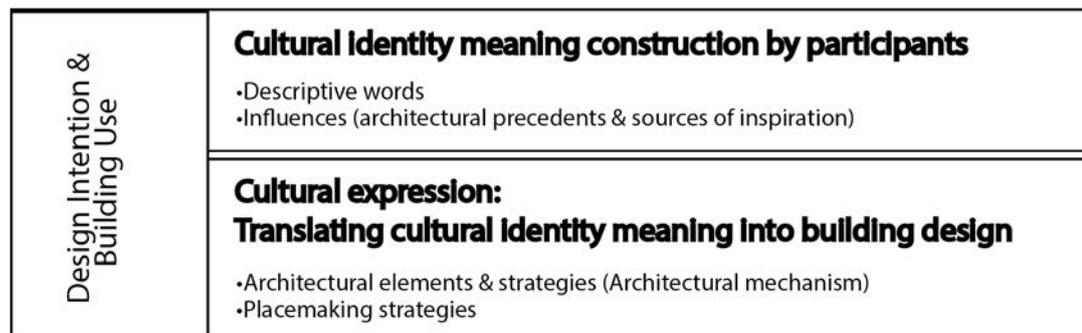


Figure 7-15: Conceived Space: Design intention and building use. Excerpt from the Findings and Discussion diagram in Figure 7-10 (by author).

To define the concept of design intention, we will reference Oakley (1970: 130), who has noted that architecture is an “association of intentions resulting in a work”. Particularly, he emphasizes on six (6) levels, represented by a “ladder” of architectural intentions. The first and second steps on its bottom relate to the problem of the building fabric, including its material and structural performance. The

third and fourth steps represent the meeting of human needs, to ensure physical protection of building users and equipment through the provision of a suitable enclosure. Higher above, the fifth and sixth ladder steps, represent the expression of human purpose in which place characteristics are defined, recognizing socio-cultural values through the selection and disposition of forms which allow users to relate to their environment. While the bottom steps focus on form, the higher ones deal with meaning (Oakley, 1970: 119, 123). Each architect must decide how high in the ladder they will climb and what intentions to fulfil in each project.

Through this research instruments we inquired about all levels of intention and realized that local architects “climbed” to the top of the ladder by including cultural considerations in their school designs. According to Oakley, architecture is a product of the problems solved, the building programme and the conceptual ordering of ideas, but is also influenced by the individual designer or team’s background. Intentions are confirmed in the architectural expression of the resulting building, shaped by purpose and its context (1970: 51, 117, 127). Inspired by these theories, the research investigated the cultural references that influenced local school designs and cultural identity construction, including styles, architects, projects, sources of inspiration, details, and project requirements. The diagram below illustrates a summary of the influences and sources of inspiration thematic analysis that will be discussed in this section (Figure 7-16).

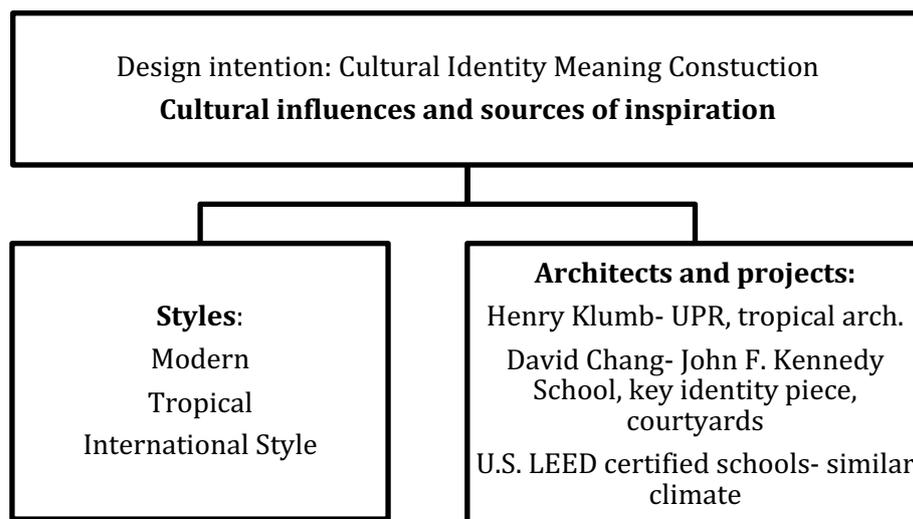
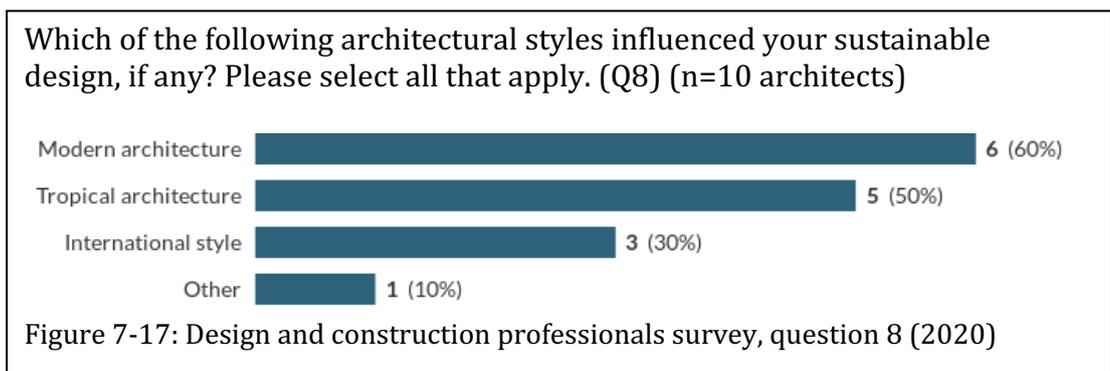


Figure 7-16: Influences and sources of inspiration diagram. Thematic analysis from the survey and interviews (Díaz, 2020).

For instance, on a multi-answer question on the survey, architects indicated that they were influenced by modern architecture (60%), tropical architecture (50%) and the international style (30%) for the design of their school projects (Figure 7-17). In line with Norberg Schulz theories in his book *Intentions in Architecture*, this research defines style as “the formal properties common to a collection of works” which secure cultural continuity (1966: 156). According to Schulz, the continued study of the experiences of the past shows that it is difficult or impossible to create a style from nothing (1966: 175). In this sense, the 20th century tropical architecture movement adapted the minimalism of the modernist style to the local context and environmental conditions, both internationally and in P.R. More recently, theorists such as Hsien-Te Lin combine tropical architecture vernacular elements such as the rectangular layout, short indoor depth, two side openings, and deep roofs with sustainable design factors such as ecological biodiversity, energy conservation, waste management, and health (2006: 109). The combination of both tropical architecture and sustainable design has been identified by Bay and Ong (2006: 2) as the Tropical Sustainable Architecture movement:

The significance of tropical architecture lies beyond its climatic and regional concerns. Inasmuch as it confronts the spread of a homogeneous globalism and argues for a locally and environmentally sensitive approach, it also signals the issues and contentions for a sustainable future.

Its characteristics are in line with local architects’ designs which referenced tropical architecture passive design concepts, conceptual ideas and strategies to shape or define the Island’s sustainable design practices, as previously indicated in Chapter 4. The mix of external influences with local cultural referents, permeate the school designs and further reinforces the idea of hybridity as P.R. identity.



According to Alberto Pérez-Gómez (2015:14), an architectural historian and theorist known for his phenomenological approach, architecture's most pressing challenge is:

Finding ways to incorporate the already meaningful habits that are present in our human cultures and to make them part of our design practices seems to be crucial to allow inhabitants to belong and even make sense of their personal lives.

In this sense, local architects demonstrated an understanding of the past, history, culture, and heritage that enabled proposals for the school of the present century. The building's style, in addition to architectural projects, concepts and sources of inspiration for their school designs, was discussed more in-depth with the architects during the interviews. Two (2) participants mentioned that they were inspired by Henry Klumb's tropical architecture legacy in the Island (IP-C1,D1). For example, IP-C1 paid tribute to the German architect through the geometric design of the school entry gates, similar to those designed by the architect in the University of P.R.'s History, Anthropology and Art Museum (Figure 7-18). Also inspired by the architectural legacy of the 1960's, IP-B1 referenced the John F. Kennedy school in Levittown by architect David Chang, characterized by its horizontal buildings with smaller patios in-between that contrast with the circular kindergarten structure that becomes the landmark or the key identity piece (Figure 7-19). This idea inspired the outdoor courtyard and circular shape of School B's cafeteria, which became an emblematic space within the project:

We wanted to make sure that there was a component of the school that was the one that awakens or detonates a little bit in the memory [of its users]... "This is the peculiarity of my school...", "I am in a school that is different from another" [...]. The school canteen is the meeting place [...]. The school canteen is sociability indoors, the patio is outdoors [...] (IP-B1).

This image has been removed by author for copyright reasons.
Original image available at:
<https://www.upr.edu/museos-2/museo-de-historia-antropologia-y-arte-de-rio-piedras/>



Figure 7-18: Sources of inspiration- Henry Klumb. Left: History, Anthropology and Art Museum designed by Henry Klumb (Universidad de Puerto Rico, 2017). Right: View of entry gates in school C that pay homage to Klumb's design (Image provided by participant).

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Original image available at:
(Fernandez, 1965)



Figure 7-19: Sources of inspiration-Architectural legacy. Top left: John F. Kennedy School in Levittown, Toa Baja, P.R. designed by David Chang (Fernandez, 1965).

Top right: School B (Image provided by participant); Bottom: School B Aerial view (Google Earth, 2022)



While the participants above were inspired by local projects and architects, others looked to the U.S. for guidance and culturally translated foreign influences to the local context. For example, QP-H1 referenced successful LEED Certified Schools in the U.S., particularly those close to the ocean, in states with similar climates.

When you see your school, which of the following words come to mind? Please select all that apply. (Q15) (n=13 architects & sustainability consultants)

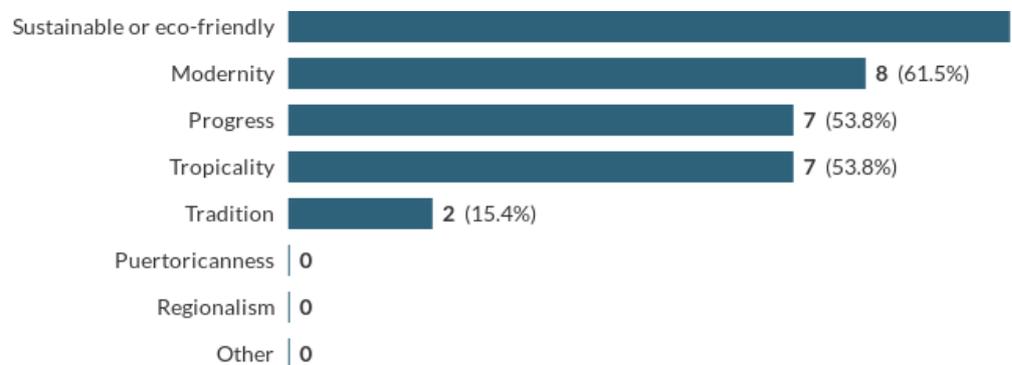


Figure 7-20: Design and construction professionals survey, question 15 (2020)

Furthermore, participants described their designs using the following words: “sustainable” (76.9%), “modernity” (61.5%), “progress” (53.8%), “tropicality” (53.8%) and “tradition” (15.4%) (Figure 7-20). During the interviews, participants who selected the word “sustainable” on the survey highlighted eco-friendly strategies employed such as the rainwater collection system which became an educational feature in School A, as well as the cafeteria’s green roof or school garden. It is important to point out that participants emphasized on passive strategies such as the use of eaves, natural ventilation, open hallways, connection to the outdoors, and breezes as sustainability elements in the project but also as justification for selecting the descriptive “tropicality”. This validates the idea that elements and strategies from the tropical architecture movement in P.R. are still used as reference for sustainably designed projects and underscores the importance of including and rewarding passive design strategies in LEED.

It was also discussed on Chapter 4, that architecture became a vehicle and part of the mid-twentieth century governmental discourse that promoted the idea of “progress” and “modernity”. This research data analysis has validated that these concepts are still relevant today, particularly in the Schools for the 21st century. This indicates a continuous top to bottom approach, particularly when dealing with federally funded projects such as this one. For example, the U.S. vision for public schools promoted by upper level government representatives in the U.S. was culturally translated by local professionals involved in the project. What started as an idea during Barack Obama’s incumbency as Senator, became a reality during his presidency. Public schools became a vehicle to reactivate the economy, create green jobs, and equip teachers and students nationwide with technological advancements. As stated during his speech in Chicago, Illinois (2006):

As the twenty-first century unfolds, we are called once again to make real this hope - to meet the new challenges of a global economy by carrying forth the ideals of progress and opportunity through public education in America.

This analysis revealed that the notion of “progress” and institutional culture of local schools is deeply influenced by the U.S. Department of Education structure and

policies, as well as those from the P.R. Department of Education. For instance, the Schools for the 21st Century project followed mainstream guidelines to equate local schools to those in the U.S. Design and construction teams had to follow the design standards developed by the American consultancy firm Fielding Nair International (FNI), as one of the project requirements. Even though they met with school community representatives, there is also an element of cultural translation involved in which they interpreted local needs to create their vision of what local schools should be moving forward. While participants acknowledged that the project was a step in the right direction, they also felt the project guidelines needed further adaptation to P.R.'s economic, socio-cultural, and environmental conditions:

[...] Fielding Nair's guides documented the process that was carried out which included visits to Puerto Rico, school visits, "workshops" with school communities ... that is, they did a process and I understand that many of the things that are in the document reflect the needs of schools in Puerto Rico. Not necessarily everything that is in there was so practical because, perhaps, they target what a school should be and do not consider the economic or physical limitations of the development of schools in Puerto Rico [...] (IP-A1).

These guides did not take into account the type of student, did not take into account vandalism problems, did not take into account maintenance problems, did not take into account ventilation or the sun (IP-B1).

Framed by foreign guidelines, in addition to those from the local government, several participants also felt that their school designs embodied the word "progress":

It is a structure that at an academic, community and contextual level represented an improvement... Progress for the country in academic terms and facilities, progress for the community since this was going to be a meeting place for them. Progress for architecture as a discipline because we used prefabrication methods [...] (IP-B1)

Similarly, IP-A1 also emphasized on the façade, materials, and the technological infrastructure of the new school:

[...] the school facade is different from what has been traditionally done in schools here, that is, you no longer have the traditional Miami windows or beams and columns [...] you have other types of materials of a little better quality and certainly because the school has an infrastructure that traditionally schools here do not have. It has computer rooms, Wi-Fi throughout the school [...]

The above quotes validate participant's belief that schools were meant to become symbols of progress for the community. This was showcased through the provision of new and/or improved school facilities, technological infrastructure, as well as in the use of innovative materials and construction techniques.

Likewise, these two participants also selected "tradition" to describe their schools. According to Schulz, this word entails that a product or building "exists in a cultural space" and expresses that forms have no meaning outside a system (Norberg-Schulz, 1966: 159). In this case, architects referenced the local historical architectural practices such as the interior patio and low relief details on the façade (IP-B1) to give meaning to their projects. It is important to point out that even though "tradition" was selected, neither "Puertoricanness" or "Regionalism" were. Even though Puertoricanness is widely used culturally, it is not frequently employed in architectural terms. Both "Puertoricanness" and "Regionalism" were included on the survey, inspired by Luz M. Rodriguez analysis of the Caribe Hilton hotel, one of the first examples of tropical modernist architecture in the Island (2013: 177). She argues that the building's modernist international architectural elements were readily visible to equate the hotel to those in the U.S. while tropicity was represented by the continuity between interior and exterior landscapes, providing a spatial experience only comprehended through the senses. This analysis also resonates with the design of case study schools that follow current international trends while emphasizing on the indoor/ outdoor connection through the use of the local patio, visual connections, daylighting and natural ventilation strategies. While in the Caribe Hilton, local expressions of Regionalism or Puertoricanness were reserved for the most intimate parts of the building such as the guest room's interior design, local school architects went beyond and included references to previous architectural traditions both conceptually or more evidently by including low-reliefs and motifs, among other elements on the façade. As further research, it would be interesting to inquire why these descriptive words were not chosen.

An internet search using the terms Puerto Rican architecture, returned the official P.R. Tourism website which highlights local historical architecture as one "shaped by

diverse cultural and artistic influences, ranging from Neoclassical, Gothic, Baroque, Colonial, and more". Today, its modern architecture samples reflect its multicultural background (Baldwin, 2021), making it a difficult task to identify a particular style with the Island's architecture. The next section will look into how participants design intention was culturally translated into local building designs and explore which architectural elements and Placemaking strategies were employed.

7.4.2.1. Cultural Identity Expression

The character of a building is evident through its elements, details and how these are related to the whole (Roche, n.d.). As such, buildings may be interpreted as **cultural artifacts** that are evidence of the cultures that made them and demonstrate the values informing their construction and use (Sharr, 2012: 3). In order to understand the character of local schools, this research referenced theorists such as Rasmussen (1964) and Parsaee et al. (2015), among others, who have identified key character-defining elements that form a building's distinctive identity and informed the development of the research instruments. Also, investigated local school's relationship to place via Placemaking strategies employed by practitioners.

It is by means of architectural elements and strategies such as solids and cavities; colour; scale and proportion; rhythm; texture; daylight and acoustics, that architects have been able to give buildings its individual character (Rasmussen, 1964: 27). According to Danish architect and planner Steen Eiler Rasmussen (1964: 29):

It is not enough to see architecture; you must experience it. You must observe how it was designed for a special purpose and how it was attuned to the entire concept and rhythm of a specific era. You must dwell in the rooms, feel how they close about you, observe how you are naturally led from one to the other. You must be aware of the textural effects, discover why just those colors were used, how the choice depended on the orientation of the rooms in relation to windows and the sun.

Furthermore, this investigation referenced Parsaee et al.'s (2015) conceptual model 'the Semiology Approach to Architecture' (Figure 7-22) that analyses a building's architectural mechanism, including its spatial organization and physical structure, as means to shed light on its users socio-cultural background and beliefs. This model inspired the development of two (2) survey questions in which participants could

select those cultural parameters and architectural mechanism elements that informed their school design (Q10) and contribute to the expression of P.R. culture (Q11).

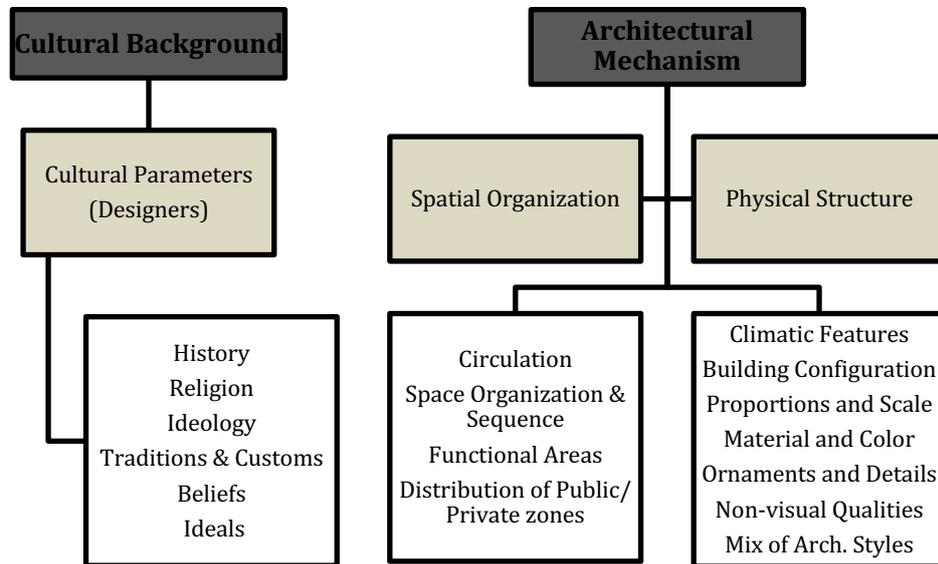
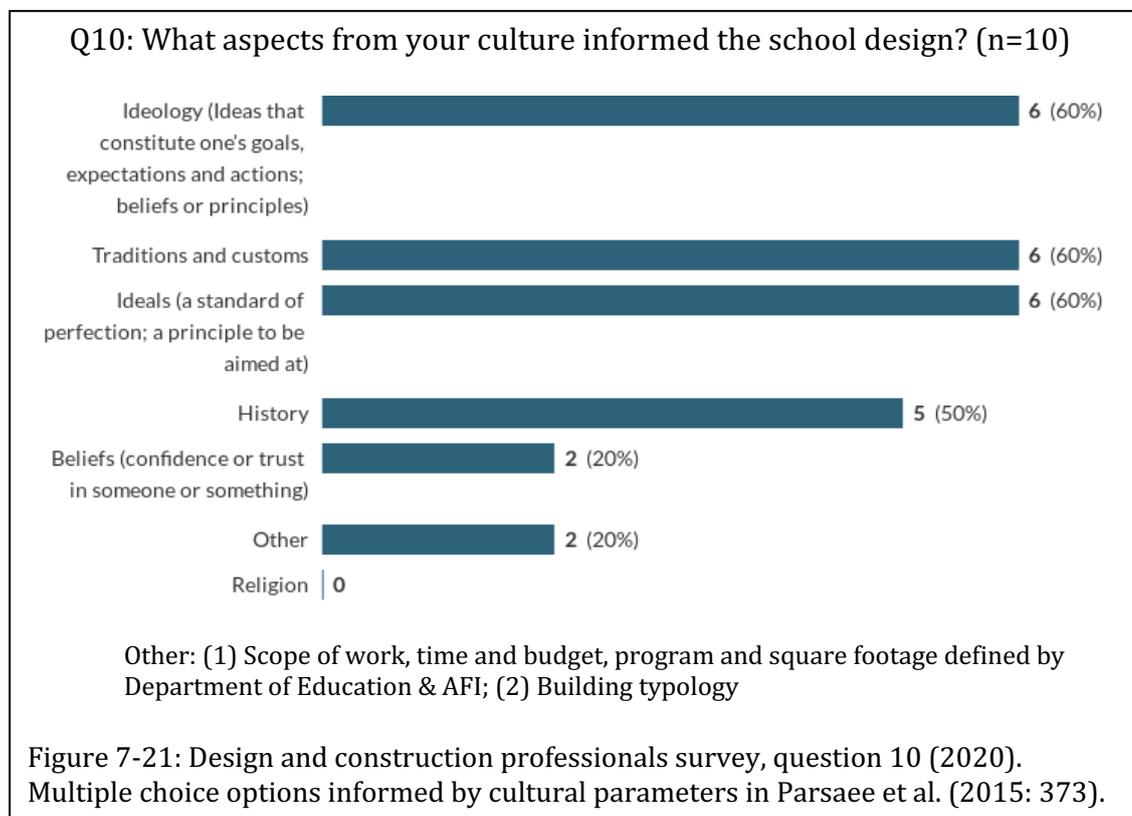


Figure 7-22: Diagram inspired by The Semiology Approach in Architecture (Parsaee et al., 2015: 373) to explore what aspects from the designer’s cultural background informed the school design and which architectural elements employed contribute to the expression of P.R. culture (survey questions 10-11).



The Cultural parameters listed on Figure 7-22 include aspects from the participant's background which informed their school design. In the multi-answer survey question (no. 10), participants mostly selected Ideology, Ideals⁵⁷, Traditions and customs (60%) and History (50%), as illustrated in Figure 7-21. According to the thematic analysis of participant interviews included in Figure 7-23, architects further discussed Ideology and Ideals together and emphasized on the principles they deem important for their professional practice, such as designing buildings that are educational tools in itself and may have an impact on its user's sustainable culture. For example, IP-E1 proudly highlighted that they designed the first public ecological school and the first LEED registered school in P.R. At the time, sustainability was something new for its users and required a change in mentality:

I think it influenced building occupants because it was the first public ecological school. From that perspective, I think that it did influence a lot because neither the teachers, nor the students, administrators, nor those who maintain the facilities were ready or at least prepared to receive something like this. [...] we gave training seminars to teachers and maintenance staff so that the school itself could become a teaching tool (IP-E1).

In addition to being a tool for teaching sustainability concepts, school E became a tool to teach students about one of the main economic activities and culture of the mountain region. Similarly, IP-D1 mentioned the impact of its rural vocational school design on the academic culture, and how the school became an aide on the teaching/learning process. Each student had an allotment garden that provided a hands-on experience on the agriculture training program. That way, the student can be given a holistic training following the seed to plate concept. The idea to "link" cultural elements in the building to the curriculum, was further explored as a standalone credit or combined with the existing LEED Innovation credit *School as a Teaching Tool* which focuses on sustainable education. This idea will be further explored in the analysis of the 2nd round of interviews and the final cultural indicators proposed as part of this investigation (Chapter 8).

⁵⁷ In the survey to design and construction professionals (2020), Ideology was defined as Ideals that constitute one's goals, expectations and actions; beliefs or principles. Ideals were defined as a standard of perfection or principle to be aimed at.

Participants also expressed the importance of sustainability considerations which included making architecture as efficient as possible considering the limited availability of materials and resources island wide (IP-E1, C1). Their professional practice ideology and ideals also included promoting social interactions and exchange between users, in both indoor and outdoor spaces (IP-A1, B1). To achieve this, school designs included communal spaces for socialization and recreation, such as the canteen, basketball court, wide hallways, patios and gazebos, typically used during recess hours (Schools B,C,D). These passively designed spaces are typically open or naturally ventilated, taking advantage of tropical climate conditions. Furthermore, school designs were informed by local historical architectural traditions and models such as the patio school (IP-A1,B1). Participants were committed to immerse themselves in the local cultural legacy, even though the architectural expression of their school buildings is contemporary (IP-B1).

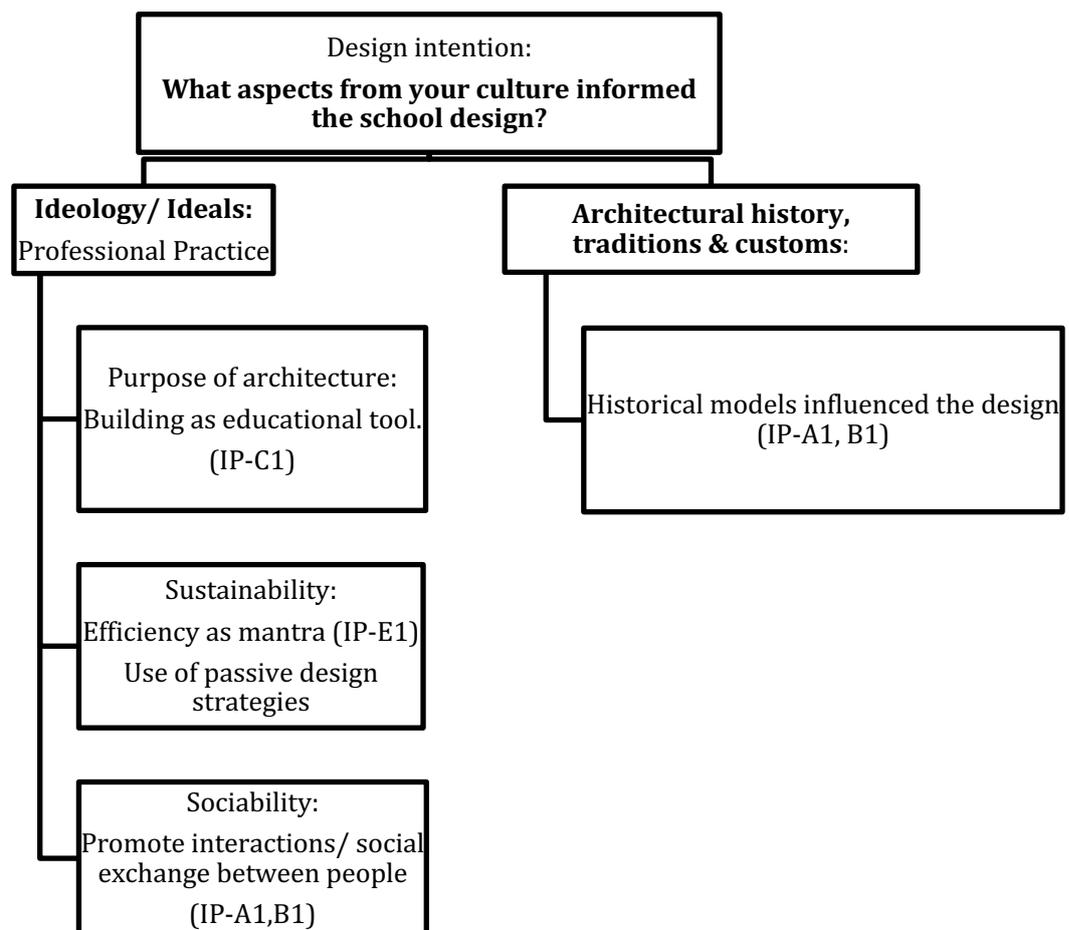
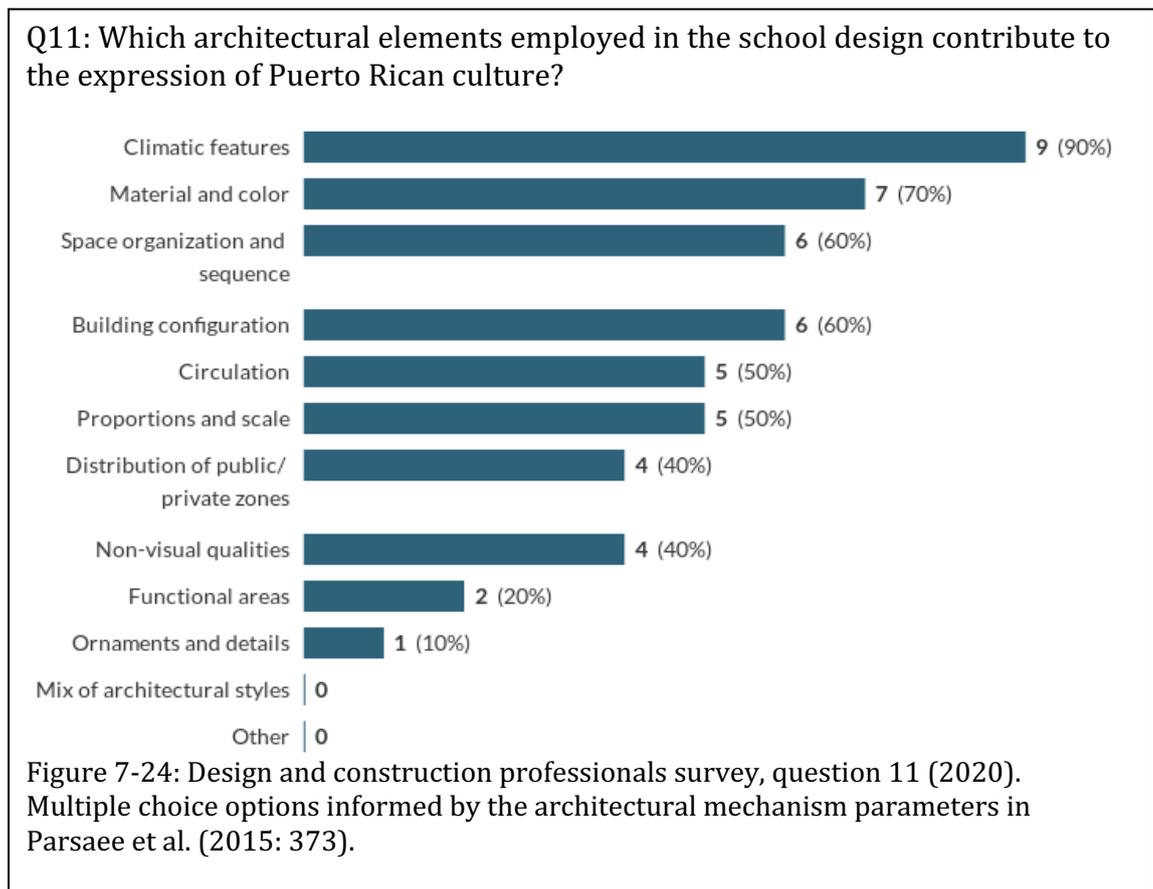


Figure 7-23: Thematic analysis summary: What aspects from your culture informed the school design? (Q10, Q14). Interviews to design professionals (2020)

In addition to determining which cultural aspects from the designer’s background informed the school designs, this research inquired about which architectural elements contribute to the expression of P.R. culture. A survey question was developed inspired by Parsaee et al.’s (2015: 373) analysis of a building’s Architectural mechanism, which includes spatial organization and physical structure (Figure 7-22). Even though these two are discussed separately in the Parsaee et al. (2015: 374) study, these were included together on the question’s preset *list of answer* choices and will be analysed jointly, recognizing the inherent connection between the physical structure of the school and the organization of its internal spaces.



Fifty percent (50%) or more of survey participants selected Climatic features (90%), Material and color (70%), Space organization and sequence (60%), Building configuration (60%), Circulation (50%), as well as Proportions and Scale (50%) (Figure 7-24). A sample of the thematic analysis performed to Q11 is included in

Appendix Q. It demonstrates that participants further commented on the use of environmental design and inclusion of climatic features, particularly passive design strategies and elements which have become part of the architectural identity such as the use of the interior patio to introduce natural ventilation, daylight, and strengthen the indoor/ outdoor connection, while also providing a multipurpose space defined by adjacent buildings. IP-B1 also emphasized on the school's open corridors that "take advantage of the natural context and temperature in Puerto Rico. Covered, without sun, for much of the day to make them more comfortable" (2020). Vertical circulation elements, including open stairs and ramps, also take advantage of the tropical climate by providing protection from the sun and rain but allowing breezes to pass through in-between buildings to maximize natural ventilation (School B).

Natural ventilation strategies also included glass louver operable windows in all schools, eaves and *brise-soleils* to protect hallways and/or fenestrations for sun-shading. More specifically, School A included an interior patio covered with a tall roof, and openings that let the warm air out aided by ceiling fans. This school design also considered the building's orientation to inform the programmatic distribution. Frequently used and naturally ventilated classrooms were oriented to the northeast, to get the best solar exposure.

Building envelope materials also had to be suitable for the Island's hurricane-prone location. Materials such as concrete and steel were typically used in local schools because of their strength and durability, particularly considering some educational facilities, such as school E, are used as safe community refuges during and after these climatic events. It was clear during the research analysis that designers also explored and experimented with colors and textures to maximize the aesthetic potential of these construction materials.

The aesthetic cultural expression of the school's for the 21st century project included a pre-determined color palette in which mostly neutral colors were complemented by accent colors that identified the school level (primary, middle school, secondary) on the façade to provide a common theme along all schools. While this concept was expressed in the Fielding Nair International Design Standards manual (2010a: 35)

for the Schools for the 21st century project, specific colors were selected locally by designers in charge of overseeing the project management. However, School B designers requested a variation on that scheme, to include multi-coloured painted bands on the façade that emulated modelling clay (Figure 7-25) and gave a particular identity to their school. This detail was inspired by the modeling clay blocks the architect used to play with as a child, and were sold at the local pharmacy. This is an example of how the pre-established color scheme was modified based on the designer's generational experience, to give meaning to a particular architectural detail.

In contrast, school E, which was not part of the Schools for the 21st century project, employs powerful intense tropical colors, as shown in Figure 7-25. According to IP-E1:

What tropicality adds to it is the simple geometry and the use of color is essential in these schools. We used very powerful colors, intense yellows, intense reds, blues, greens, that could be related to play (2020).

Furthermore, the participant identifies this color palette as part of the school's tropical identity, based on aesthetic considerations but also highlights that colors were selected for a specific purpose or function, for example, they used yellow in the interior for insect control:

We used colours that one would associate with tropicality. Almost all the ceilings are painted yellow, that is almost like a signature in our projects. Light reflecting off a yellow surface, just like the light coming out of a yellow light bulb, has a frequency insects don't see. So, if we have yellow lights with a yellow ceiling, even if the light is not on, the light that bounces off the yellow ceiling has the same frequency and that helps to mitigate the presence of insects (IP-E1).



Figure 7-25: Material and colour selection in local schools. Left: School B coloured bands on façade that emulate clay (Image provided by Participant). Right: School E color palette related to tropicality and play (Image from El Nuevo Día newspaper)

Both material and colour selection have an impact on the school image, attractiveness and street presence, which were also Placemaking strategies marked as important by professionals on the survey, as will be further discussed on section 7.4.2.3. Strategies employed by professionals, including their definition of tropicality, color and material selection criteria and application, will inform the development of LEED aesthetic- related credits for the local context.

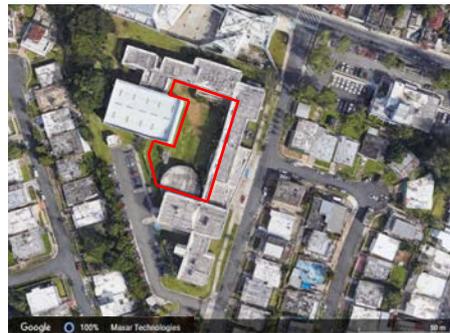
Local cultural identity expression also manifested on building configuration, overall size and shape, and space organization. Case study school's building configuration was mainly focused on the use of the courtyard as the primary organizational element. The Design Standards manual developed for the Schools for the 21st century project by Fielding Nair International (2010), stated that many of the educational facilities visited included green open courtyards that were under-utilized, and that there was little evidence that the open space was consciously designed for learning or play. The design standard recommendations, include that courtyards may be used to create playing fields, extend indoor learning spaces, increase planting, and provide additional natural cooling through shading of buildings and play spaces (2010: 12). It could be thought that case study schools have a courtyard because of FNI design standards recommendations. However, during the interviews, participants did not mention that document, instead stated that their patio design was influenced by P.R.'s architectural legacy:

The patio school... the patio as a place of sociability. In Puerto Rico, it is particularly interesting because the patio is a spatial element that makes the

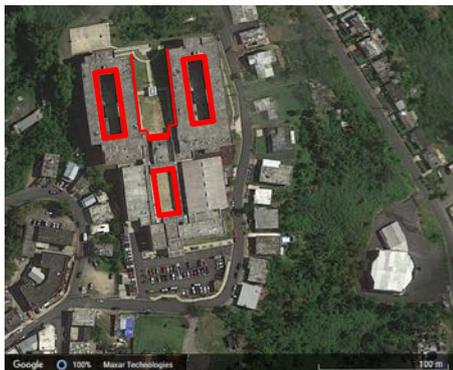
leap, meaning that you find it from "Spanish colonial" architecture up to Modernity [...] (IP-B1).



School A



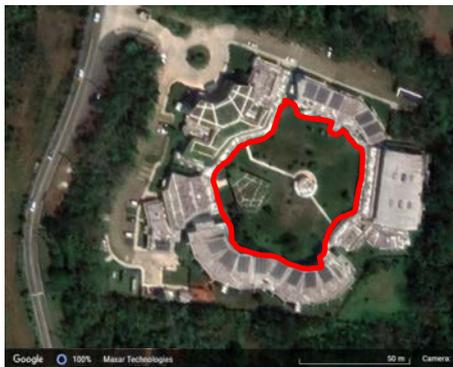
School B



School C



School D



School E

Figure 7-26: Aerial photos of case study schools (Google Earth, 2022)

The provision of outdoor courtyards also contributed local schools on the mainland ($n=8/9$) to earn LEED's *Open space* credit. Furthermore, six (6) of these schools obtained an additional Regional Priority bonus point because this indicator was listed as a priority for the project's location. This credit was also selected of high importance on the survey. Local designer's strategies employed to earn this credit and the difficulties encountered in the process, will inform the revision of this existing indicator.

The *Open Space* credit currently allows a degree of flexibility, proven by the different variations in the courtyard's shape, programming, and materiality, as shown in Figure 7-26. For example, Schools A,B,C,D followed rectilinear shapes (rectangular, triangular, L/U shaped), while case E presented a more organic configuration (Figure 7-27). School A, for example, was organized around three inner courtyards defined by its buildings, one of them roofed. However, school C, was inspired by the town square, in which the school's main functions are located around a central plaza: the theatre, administrative offices, the basketball court, the canteen and the library (IP-C1). The school is organized around a central, longitudinal main axis, partially interrupted by the library's glass building which still allows the user to maintain a visual connection with the back patio. IP-C1 expressed that the library is the heart of the school, to justify its prominent location. At the back, the buildings that define the main axis, have inner courtyards as well. The route ends with an open amphitheatre or contemplative space allowing views to the surrounding mountains.

School B provides a variation on the rectangular patio scheme, with an opening on one side, similar to an "L" or "U" shape sitting on a triangular lot. Also, prominent programmatic elements such as the basketball court or community pavilion and the round school canteen protrude into the patio. In contrast, school D presents a triangular central courtyard, which provides a more contemporary twist to the traditional patio configuration, informed by the site's topography, and inspired by another green school designed by the office which follows a similar shape. School E's large interior garden follows a more organic shape defined by pavilions and connecting circulation elements.

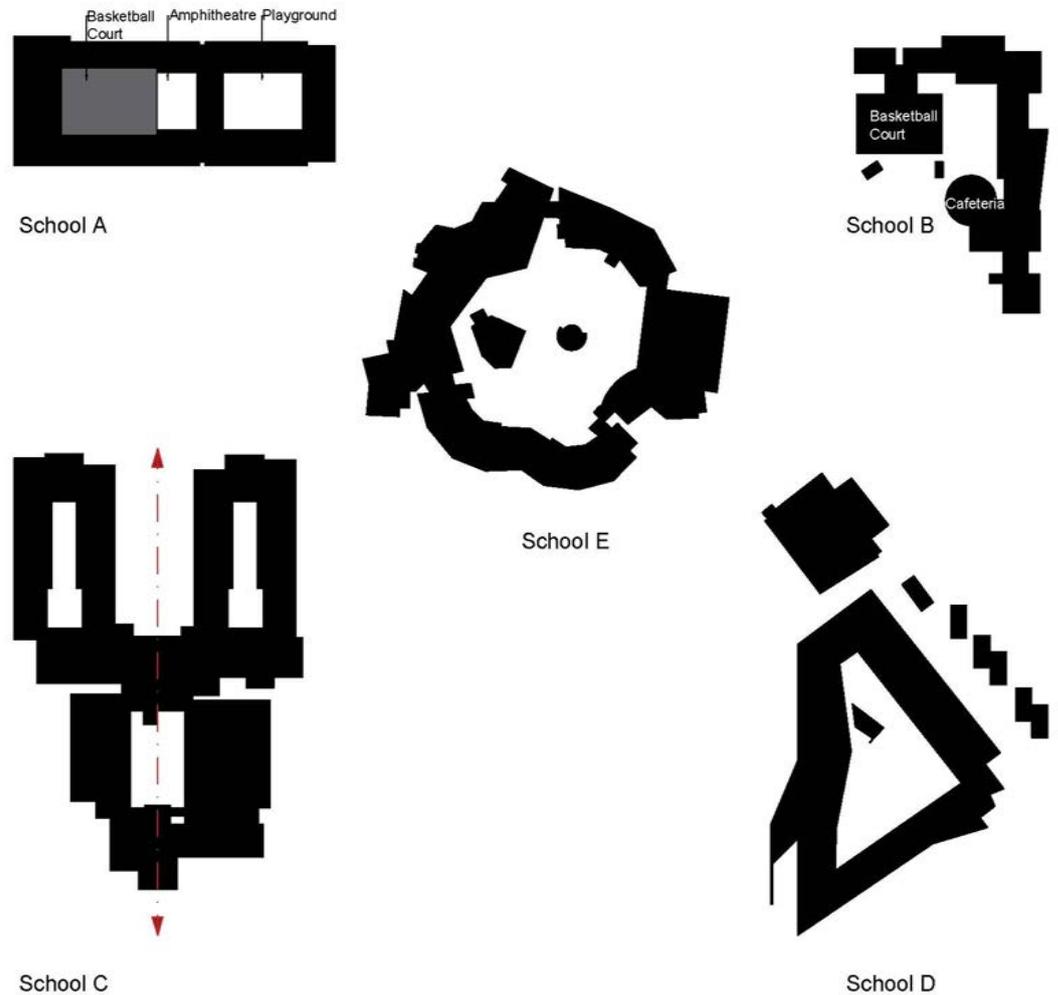


Figure 7-27: School Patio Diagrams (by author). Based on drawings provided by participants and Google Earth images.

In addition to being an organizational element, the patio in P.R., also becomes a tool to strengthen the relationship between the user and its surroundings through physical and visual connections, an aspect that could be strengthened on LEED's *Open space* credit. According to Bruno Stagno (2001: 177, 183), everyday experiences or *vivencias* form and express our personalities:

In tropical latitudes people live out their relationships with the environment in a particular way. Existing in a benevolent climate, but where coolness is a sought-after relief, the body becomes sensitive to slight changes of temperature and humidity. If someone wants to rest he or she will move their chair to take advantage of any breeze, until the most favorable spot has been

found. This constant search for breeze and shade means that there is no one place in the house set aside for social intercourse [...]

In these latitudes it is the shadow, which illuminates life, which unites and motivates *vivencias*, since the intensity and excessive heat associated with light make it uncomfortable.

Stagno's quote presents the shadow as a defining element in the tropics, sought after for comfort and socialization. As shown in Figure 7-28, students benefit from the shade when using the patio, particularly during recess time. Even though most schools included shaded areas, gazebos or pavilions, they may have benefited from additional shading in some areas.



Figure 7-28: The shadow as defining element. Top left: Gazebo on School D patio. Top right: Children play area, shadow cast by surrounding buildings in School A. Bottom: Children playing in shaded areas on the patio and gazebo (Images provided by participants).

Clearly defined circulation paths contribute to user wayfinding and space organization. In schools C and D, for example, designers responded to the sloping site's topography by placing buildings on different levels and connecting them through ramps or stairs/ bleachers which become additional gathering spaces (Figure 7-29). According to IP-C1:

Everything is organized around clearly defined circulation paths... I understand that children live in a confusing environment where they have too much going on at the same time and I believe that this school should provide a safe environment and that the architecture should offer tranquillity, places where they can study and shelter from the rain and from the sun. In all the schools that I visited, both public and private, there was a total lack of spaces for students to hang out during their free time and everywhere I saw people sitting on the floor and in the hallways [...] Well, we tried to provide spaces where they can sit and hangout [...] in the amphitheatre, in the plaza, on the stairs, for example, benches are created just below. In other words, in the lobby of each building there is a space where they can meet, sit, and wait instead of sitting in the hallways...

In most schools, wide open hallways became a roofed extension of the courtyard and a socialization space, providing a transition between the outside and inside (Figure 7-29):

[...] there is sociability because the corridors face the inside, not the outside. The hallways lead to the patio. That makes everyone look at themselves and see the activity. So, the patio has wide corridors ... expansiveness... the school feels like a place where people can go back and forth through the corridors, and they are not stumbling [...] (IP-B1)



School C: Stairs and bleachers that connect the different levels and become socialization spaces



Left: School B: Bench under ramp, Right: School D: Open hallways facing the outdoor courtyard

Figure 7-29: Circulation elements (Images provided by participants).

Proportions and scale were also considered as a cultural identity expression element by survey participants. The implementation of these concepts may impact the development of the *Aesthetic Quality of the Building* and *Impact on Existing Streetscapes* indicators selected by participants on the survey as important for the local context. The analysis of interviewee responses revealed that design teams employed these elements in different ways, within the building itself and in comparison with the surrounding context. In terms of the building, School A designers focused on creating three (3) different patio environments at different scales. In this case, the basketball court was located on a roofed courtyard, followed by a smaller patio with an amphitheatre and lastly a green area defined by the library and other supporting spaces.

The five (5) selected case study schools were designed with two (2) to three (3) stories high, mostly to compensate for the extensive program and relatively small lots. In that sense, schools look quite massive compared to the small scale of the residential/ suburban areas or natural/rural sites and become a landmark. However, other green schools made an effort to blend-in with the surrounding residential context by creating smaller buildings or pavilions (Schools G,H) (Figure 7-30). Even though proportions and scale varied, these were clearly justified by participants and tied to the architectural concept.



Figure 7-30: Smaller scale green schools. Left: School G pavilions blend-in with the surrounding residential neighbourhood. Right: School H: Drop-off and main façade blends in with the surrounding context. (Source: Images provided by Participants)

Figure 7-31 summarizes the architectural strategies discussed and employed in local building designs as means to understand designer's cultural identity expression in the local context.

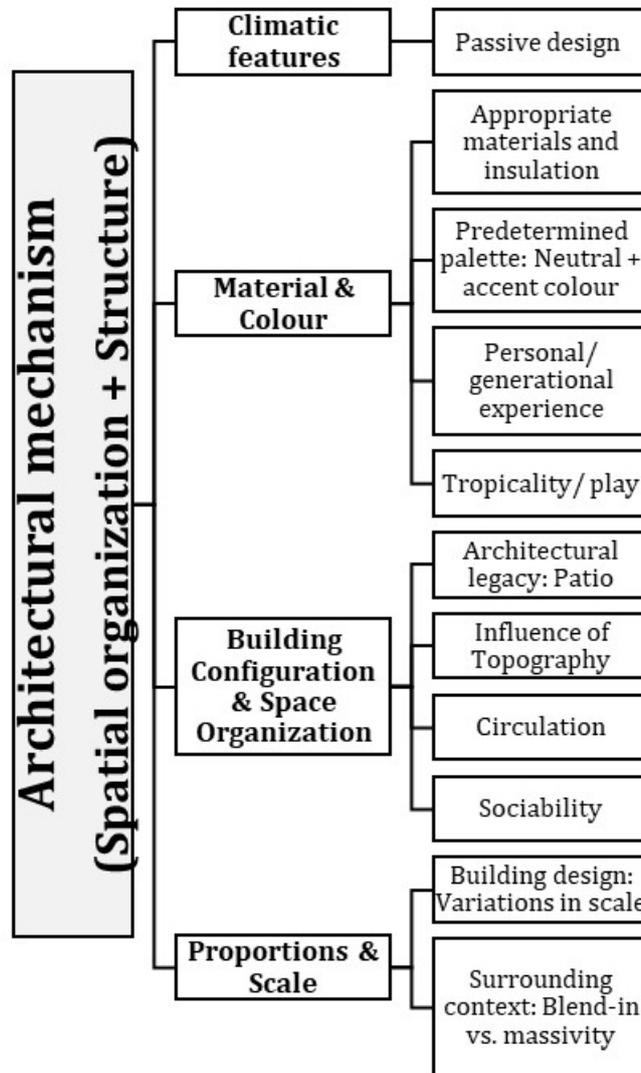


Figure 7-31: Summary of architectural mechanism strategies employed in local schools

Even though the use of symbols is not explicitly included in Parsaee et al.'s (2015) architectural mechanism, it was another vehicle employed by participants to express the local culture. This research referenced Schulz to define symbolization as an experienced meaning that is translated into another medium. This implies the transposition of meanings to another place in which symbols become cultural objects (Norberg-Schulz, 1980). On the survey, participants were able to select from a list of distinctive “nationalist iconography” those that were incorporated in local schools

(Question 14, Figure 7-32). According to Duany (2002), these symbols have been promoted by the Institute of Puerto Rican Culture and other government agencies since the mid-1950s to represent cultural beliefs and ideologies. Even today, local designers employed both literal P.R. symbols such as the flag on classrooms, which is required by the DEPR, and murals developed by local artists or the school community, which featured local landscapes and fauna. However, architects employed mostly abstract references such as endemic flora in landscaping (54.5%) that require less irrigation and better adapts to the local climate while also contributing to the achievement of LEED Sustainable Sites credits.

However, several participants interview responses call into question meanings attributed to national popular cultural symbols. For example, IP-B1 also interpreted design features such as low relief details on the façade as echo of P.R.'s architectural legacy. Similarly, IP-E1 commented: "I would think that the Puerto Rican culture would also include the roofs and interior patios, etc. I think that is part of the culture" (Interview 2020). In this sense, participants interpret architectural features as symbols of local culture (Figure 7-23). Other intangible heritage elements such as Taino (Indigenous) symbols, hymn, P.R. literature, myths and legends, holidays, and festivities, among others, which were not selected by designers may still be part of the local school culture via its curriculum. For example, local festivities such as the Puerto Rican Fest, are held on the community pavilion/ basketball court on school D, to celebrate the discovery of P.R. by the Spaniards and the local culture with typical music, dancing and iconography (Figure 7-33). In this case, the space designed by the architect, is activated by intangible heritage elements employed by the school community, space use and appropriation. Further research could determine the presence of these intangible elements in the school environment, the spaces used by the school community for cultural exchange and their adequacy.

Q14: Which symbols of Puerto Rican culture were incorporated in the school design?

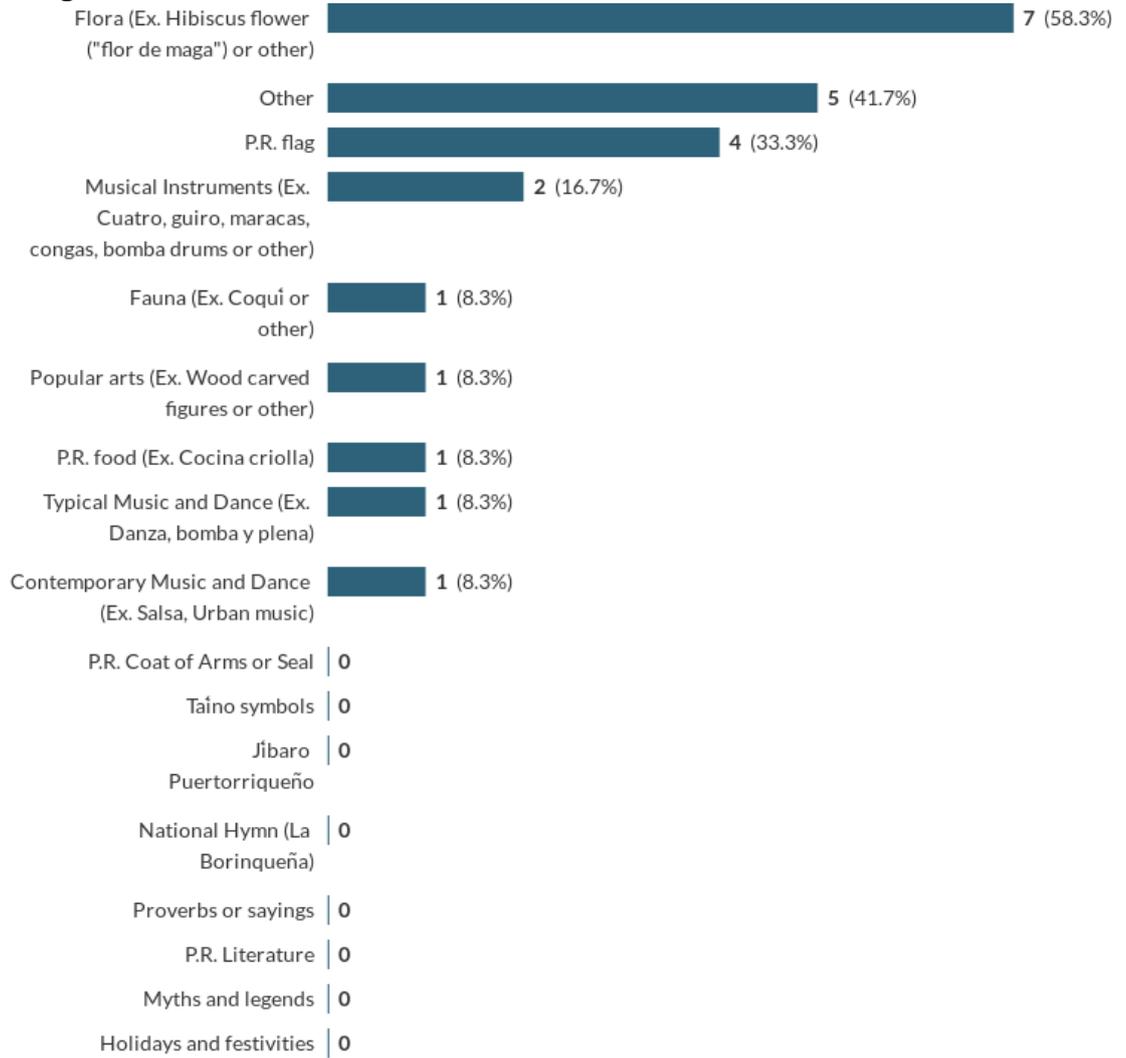


Figure 7-32: Design and construction professionals survey, question 14 (2020). Multiple choice options informed by Duany (2002).

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Figure 7-33: The Puerto Rican Fest in School D featured students dancing to typical music (*bomba* and *plena*). Decorations included the P.R. flag, coqui frog, Indigenous symbols, as well as a sentry box from Old San Juan historic fortifications. Words state "Yo soy Boricua", which is a Puerto Rican identarian phrase that indicates belonging to the P.R. culture (Image source: School's Facebook page).

7.4.2.2. Placemaking

Places are "spaces with a distinct character" and is "where life occurs" (Norberg-Schulz, 1980: 5). Places are made up of material things with properties such as shape, texture and colour that determine its "**environmental character**" or essence (Norberg-Schulz, 1980: 6). Through the past sections we have examined the character of local schools through the architectural elements and strategies employed by professionals during the design and construction process. In this section, we will analyse Placemaking (PM) strategies employed by participants as part of the local architectural cultural expression.

According to Norberg-Schulz (1980), the task of the architect is to create meaningful places. The user of a space is able to "dwell" when he can identify himself and experience the environment as meaningful (Norberg-Schulz, 1980: 5). "The place is the concrete manifestation of man's dwelling, and his identity depends on his belonging to places" (Norberg-Schulz, 1980: 6). It is clearly stated that "identification" is the basis of man's sense of belonging (Norberg-Schulz, 1980: 22).

On Chapter 3, we had proposed using Placemaking as a concept to further advance and promote sense of belonging in schools. Also, to promote engagement and involvement of the school community in the “making” of meaningful places. To operationalize the concept of Placemaking in local schools, this research referenced the Project for Public Spaces (PPS) *Place Game* which serves as a diagnostic exercise to evaluate Places in four categories: 1) Access and linkages; 2) Sociability; 3) Uses and activities; as well as 4) Comfort and image. Using this tool, community members can evaluate places by assigning a rating (1-4; poor-good) to each item. However, a modified and adapted version of this instrument was developed and used with architects and sustainability consultants in the survey to build a ‘cultural profile’ of schools in P.R. and determine what sources of “placemaking” informed the school designs (Questions 16-20).

In addition to modifying several premises to better adapt the tool for schools, a fifth category was added and labelled as Design. Modifications to existing items and those added were based on the International Comparison of SAS results and other Placemaking references such as the Dumfries and Galloway Council Design Quality and Placemaking standards (2018). A summary of these changes is included on Appendix R. Through further research, professional responses could be compared with the community evaluation of school places.

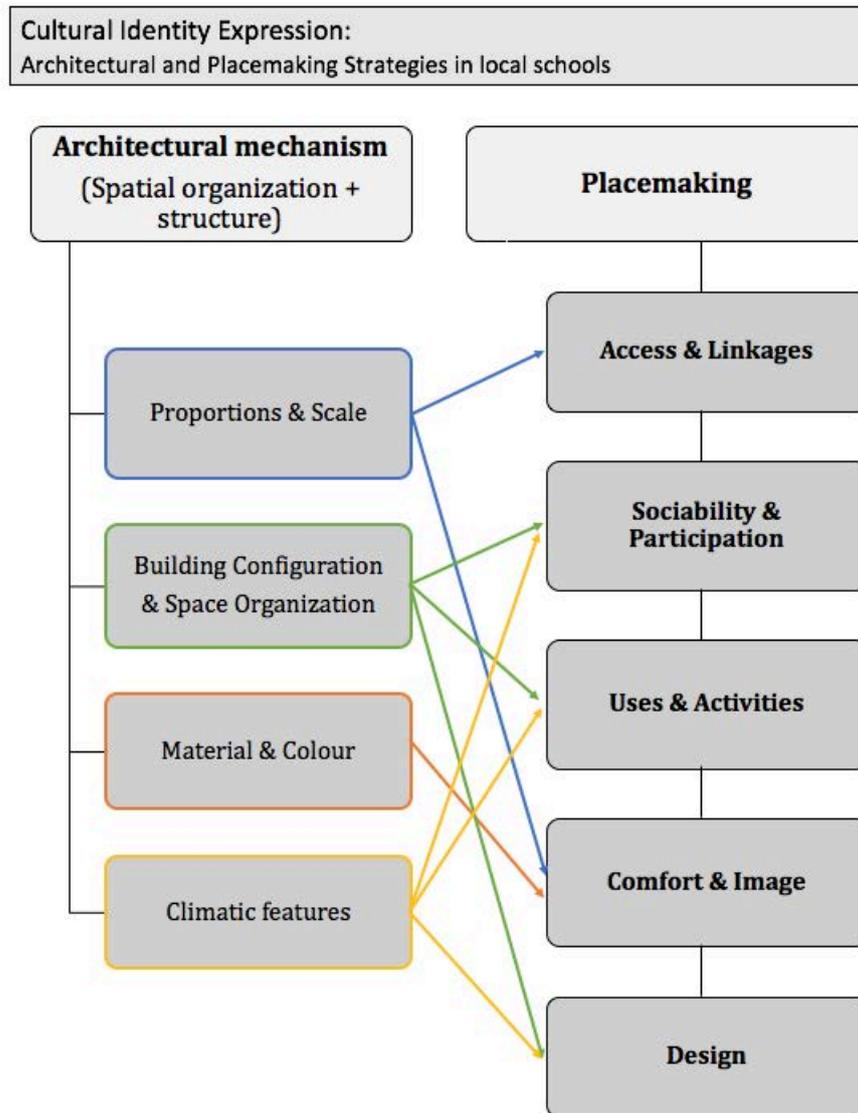


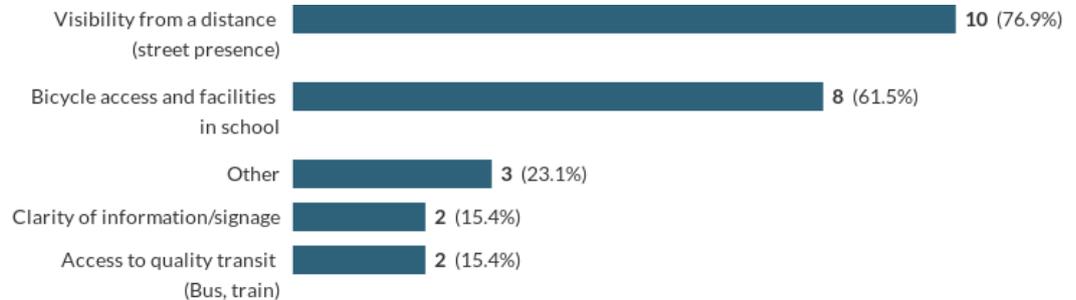
Figure 7-34: Alignment between architectural mechanism elements and Placemaking strategies. P.R. specific elements employed by participants in local schools will be analyzed under relevant PM strategies. These, in turn, will inform proposed LEED indicators.

This section will discuss those Placemaking strategies employed by at least 50% or more professionals in local schools, in each of the five (5) above-mentioned categories. The research analysis will also point to overlaps between P.R. specific architectural mechanism elements discussed on the previous section and PM strategies (Figure 7-34). For example, on the survey, professionals confirmed that “school visibility from a distance” (76.9%) under the Access & Linkages PM category, (Figure 7-35) informed their school design. This can be related to the “wayfinding” concept expressed by urban theorist Kevin Lynch in his book Image of a City

(1960:46). He argues that mental images exist in the minds of the people who experience the city and its elements, namely, paths, edges, districts, nodes or points of interest, and landmarks which are visible over a long distance. Landmarks are of particular interest in this research considering the idea of the school becoming a point of reference within the community, as indicated by FNI standards (2010) and interview participants (IP-A1, IP-E2). This research also identified a link between this PM strategy and the Proportions and scale architectural mechanism element previously discussed, to inform the development of the proposed *Impact on Existing Streetscapes* credit. While Proportions and scale focuses mainly on the building's street presence and relationship with the immediate context, the PM strategy emphasizes predominantly on non-visual qualities that aim to strengthen sense of belonging in schools. A combination of both tangible architectural mechanism elements and intangible non-visual PM strategies employed in local schools will inform the development or revision of LEED indicators. In this sense, proposed LEED credits will incorporate applicable Placemaking requirements to include more qualitative nuances in the system that make the user an active participant in the space. In other words, professionals will have to comply with PM strategies to earn the proposed credits.

Q16: What sources of “placemaking” informed the school design?
(Please select all that apply)

Access & Linkages



Other: (1) The openness of the entrance design is inviting to all visitors. Integration between interior and exterior areas is an overarching theme throughout the design that starts at the entrance. (2) Enclosed patio. (3) Unfortunately, this school is somewhat removed from the urban fabric but the decision to make it an agricultural vocational school goes well with the semi-rural context of the site.

Figure 7-35: Placemaking strategies (Access & Linkages)

This research identified key concepts on the FNI Masterplan that could be related to Lynch’s wayfinding elements, the PM category Access and Linkages and could be included on LEED. Following Lynch (1960), elements such as signage, artwork, colour, and scale, which are architectural elements that may emphasize an object’s quality as a landmark, were employed in local schools. For example, the schools that were part of the 21st Century Project included a “welcoming” and clearly marked entrance, with an area protected from the sun and rain for parents to drop off and pick up their children, which in turn impacts user comfort, another PM category (School C) (Fielding Nair International, 2010b: 58). According to IP-A1:

[...] we really wanted the school to be seen when you pass by the country road [...] well that the school had street presence, that there was no way that you would not see it and we tried to create a landmark in the place [...] and, again, there is a huge difference from what was already there to what there is now, in that sense, I think we succeeded.

However, it is important to point out that even though School E is not part of the Schools for the 21st century project, it included an “open” entrance design to make it

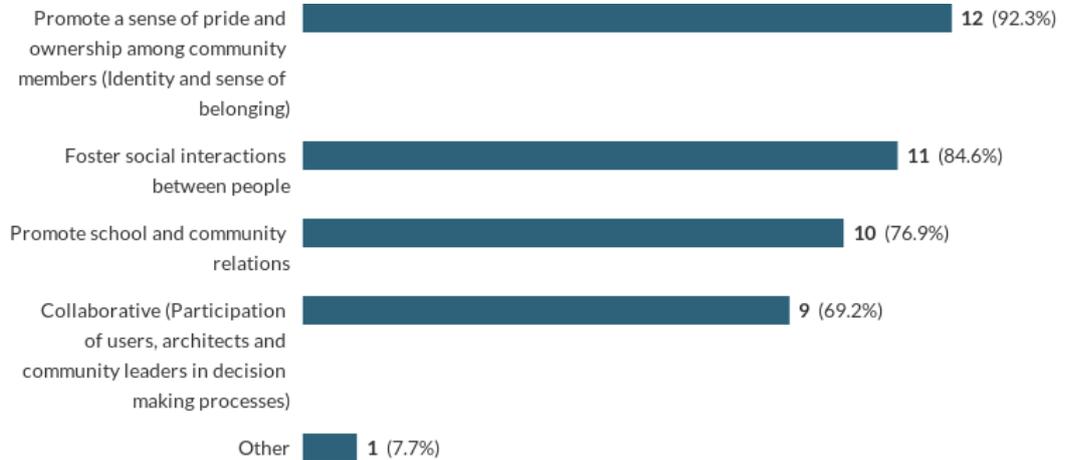
more inviting to visitors. According to IP-E2: “Integration between interior and exterior areas is an overarching theme throughout the design that starts at the entrance.” This highlights the importance that local architects give to entry design.

Some schools included distinct signature elements in visible locations, such as the institution’s name, artwork, among others, to mark its identity, as recommended on the FNI Masterplan. However, several architectural firms went beyond to include other identarian elements that are not as evident, such as the round school canteen in School B and the green roofs that serve as a planting laboratory for students in the agricultural vocational school D.

In addition to *street presence*, some professionals (61.5%) also selected on the survey *Bicycle access and facilities* as one of the PM strategies employed. While the inclusion of bicycle racks and provision of adequate facilities earned them the corresponding LEED credit in the Location and Transport category, participants recognized that few kids cycle to school because there is no bicycle network in the area. In this sense, the “path” defined by Lynch (1960), that allows users to move in their bicycle from one point to another, is unavailable. Participants identified this as an “easy” LEED credit, but recognized it was not a realistic approach for local schools because it will not be used as intended (IP-A1, C1).

Q17: What sources of “placemaking” informed the school design?
(Please select all that apply)

Sociability and Participation

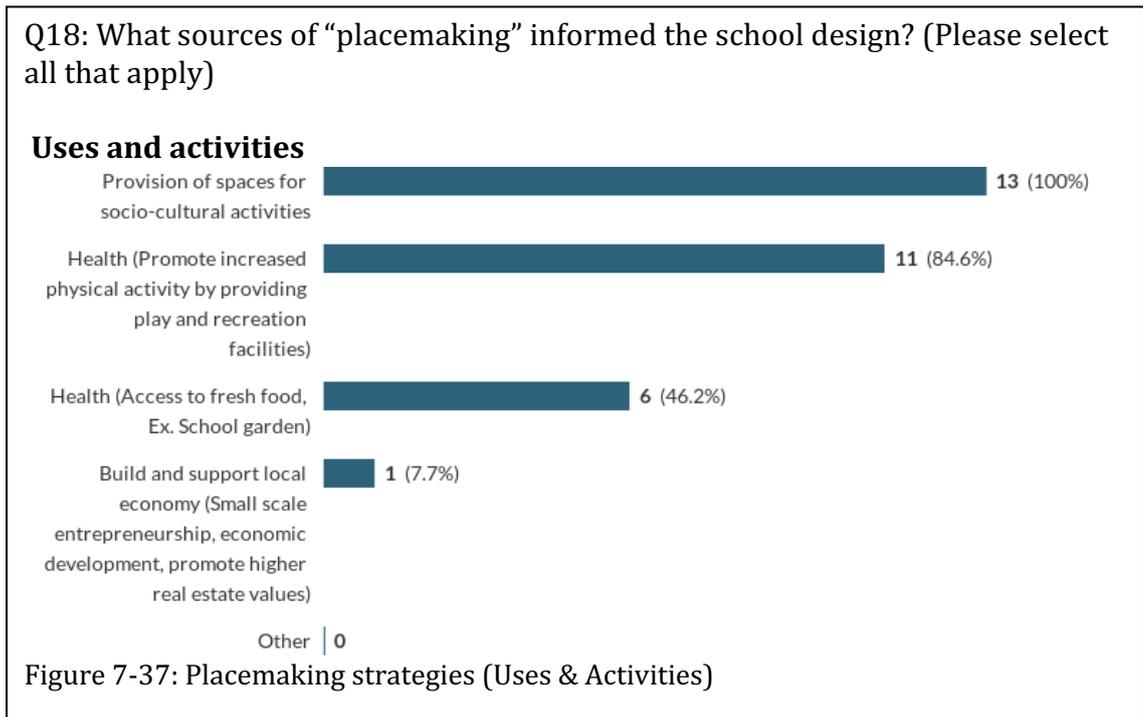


Other: (1) Connection to Boys and Girls club

Figure 7-36: Placemaking strategies (Sociability & Participation)

However, the **Sociability and Participation** category proved very relevant for the local context, considering all items were selected by the majority of professionals (Figure 7-36). It is important to point out that the original PPS (2005) Sociability category was modified to strengthen the community participation component in the title and its items. In particular, professionals emphasized on the provision of opportunities for **social interactions** and collaboration in decision making processes as a way to **promote sense of pride and ownership** among its community members:

[...] we tried to create spaces that encourage the community to share and gather together... and that the building spaces are part of what people already see as their place, their home, their space ... beyond what perhaps happens in traditional school buildings that one has buildings scattered everywhere and there really is no sense of belonging to their space and in this case, yes, I think that is something we achieved (IP-A1).



It is relevant to acknowledge that building configuration and space organization included the development of meeting places throughout the schools. Also, benefited from the local tropical climate that allows both gathering indoors and outdoors throughout the year. The *Provision of spaces for socio-cultural activities* component in the PM category **Uses and activities** is directly related to Sociability and Participation. For example, communal spaces like the patio, community pavilion, amphitheatre, wide hallways, bleachers, among others became places of sociability where users can meet and share. Furthermore, the Schools for the 21st century project encouraged the inclusion of multi-use spaces and after school programs so that the students and the surrounding community could use it during extended hours. The overall vision was that the school welcomed the nearby community to carry out professional development activities, meetings, among others (IP-K1). Furthermore, the FNI masterplan states (Fielding Nair International, 2010b: 58):

It is known that community involvement in schools is a key factor in their success and so the community needs to feel that the school belongs to them.

This welcoming aspect has to be balanced by the need to secure the entry and separate its publicly accessible spaces from the student areas.

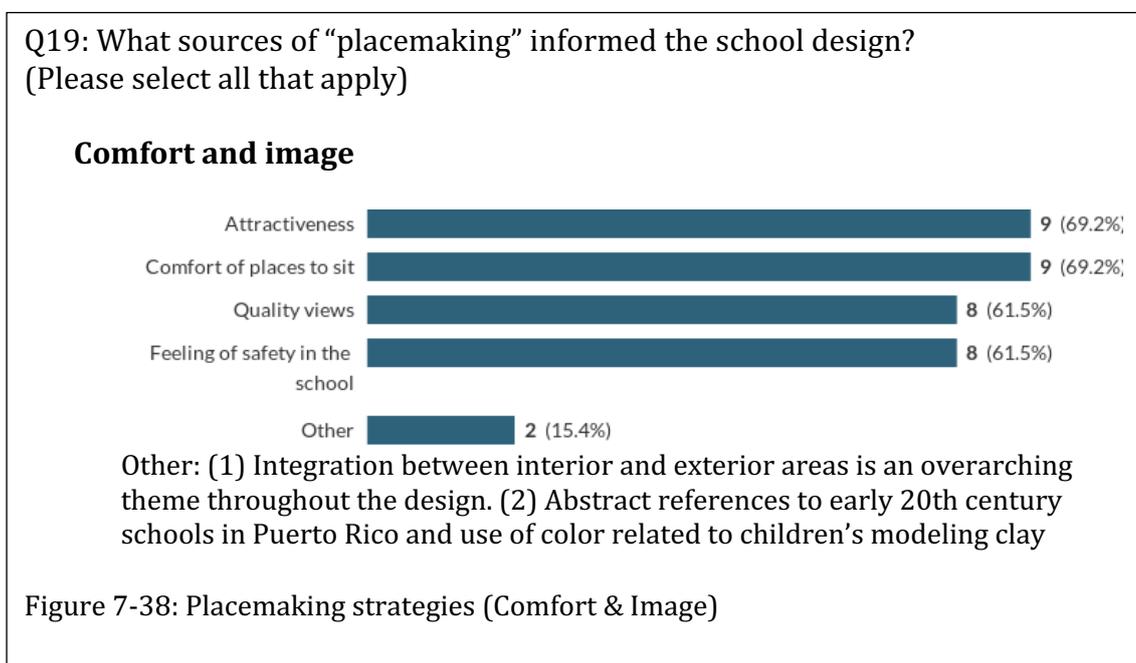
Case study schools designs integrated community spaces, such as the basketball court, multipurpose rooms and others with an independent entry, access to restrooms and parking. Usually, these spaces were located close to the main vestibule or to a secondary entrance. Some participants, such as this one, told success stories that showed that the community was integrated to the school:

Promote a sense of pride and belonging to the school... I believe that we did achieve that because [...] I was told that at the time the community took over the school, that certainly the spaces that were added such as the community pavilion were being used a lot. (IP-A1)

However, several participants stated that the spaces were provided but they were unsure if they were being used by the surrounding community as planned. IP-J1 commented that there was resistance to lend these spaces to the public whether for liability or security concerns. Also, maybe lack of resources to provide security personnel after hours. Likewise, observed there is a need to educate school management personnel on topics such as these and explore the idea of formalizing an agreement between private, non-profit or community organizations to share the management and maintenance of these spaces.

It is important to point out that the provision of community spaces contributed to the achievement of the LEED credit *Joint Use of Facilities*, earned by five (5) out of the nine (9) case study schools in the mainland (55.6%). Professionals also selected this credit as important in the survey administered. While some interview participants indicated that the school designs and communal spaces were determined by the DEPR with input from the community and met with the school director during the process, others never had the opportunity to meet with the school users (IP-A1,B1,C1). The revision of this indicator credit would need to be informed by the Collaborative Placemaking strategy which encourages the participation of users, architects and community leaders in decision making processes. Community consultation may inform which spaces are needed and promote user involvement in the operations and maintenance of these communal spaces.

In the Uses and Activities Placemaking Category, professionals also encouraged user health through the promotion of increased physical activity by providing play and recreation facilities (84.6%), in interior patios, basketball court, and playgrounds, among others (Figure 7-37). IP-D1, recognizes that even though design and construction professionals provide the spaces, programming has a very important role in promoting user’s sense of belonging, so that students have additional activities besides those delivered in the classroom both during and after school hours.



Similar to the Sociability and Participation Placemaking category, all items under PM’s **Comfort and Image** were selected by 50% or more professionals (Figure 7-38). Participants strategies may inform the development of proposed indicators related to the *Aesthetic quality of the building*. During the interviews, participants mentioned that building technologies, the building façade, and the relationship of the building with its context were key to portray the school’s image and attractiveness. Interviewees made comments about how the use of modern materials may impact the school image. For example, School A was constructed using a steel structural system with columns located in front of the façade to allow a much more linear reading instead of the traditional design of concrete columns and beams (IP-A1).

IP-A1 recognizes that local schools are very different from the aesthetic of buildings designed by international star architects: “[...] it is perhaps not that image that we all have, especially architects, of what is an eco-friendly building...” (2020). This points to the particular identity of local buildings, adapted for the tropics and local context. Some school buildings were designed to blend-in with the local context while others become a landmark in the existing streetscape whether by scale, massiveness, colour or other, as indicated on the architectural mechanism analysis on the previous section. According to IP-A1:

Unfortunately, the majority of school buildings here are an “eye sore”, they are a problem in the community, they are not a landmark, they are not a building where people feel ownership, or identify themselves in terms, perhaps, of image. How do you get those buildings to change that mentality and to improve the “streetscape” as you say here, you definitely have to integrate somehow... Certainly, when people start to see the school building in a different way, these things will change.

Several buildings provided a connection with the surrounding natural context by providing quality views. For example, school C is organized around a central axis that allows views through the library glass building and culminates with an open amphitheatre with scenic vistas to the nearby mountains. Similarly, school D classroom windows allow visual connection towards the interior central patio where the collaborative spaces are. This contrasts with previous P.R. school models which have no visual access to this green space due to the lack of windows overlooking the courtyard and the security metal doors used to shut off each classroom (Fielding Nair International, 2010b: 45).

According to the FNI masterplan, the most common “prototype” school in P.R. composed of single-loaded corridors connecting a long row of classrooms was very difficult to secure and required extra security bars that made schools feel prisonlike (Fielding Nair International, 2010b: 26,48). Opening up indoor spaces, connecting them to the outdoors more effectively, and using high quality security glass windows minimizes the need for security bars, offers natural light and provides increased transparency (Fielding Nair International, 2010b: 26).

Ensuring a safe and secure environment is a growing challenge for schools' Island wide: theft, fights, bullying, intrusions, vandalism, robberies and assaults are some of the problems that affect students, teachers, personnel and, ultimately, the DEPR who is responsible for the public education system. Top priority was given to provide perimeter security for all schools through design, building shape and envelope, use of gates, security personnel, video surveillance, among other strategies (Rizzatti, 2021).

Being an important design consideration for local schools, it is no surprise that participants selected the “user’s feeling of safety” as important on the survey (61.5%). In several new projects, such as School B, the perimeter buildings that define the enclosed patio became a wall that helps secure the school, while allowing for the use of smaller sized gates for entry/exit:

In terms of security, we tried to make it... this is an elementary school located close to three public housing developments and the way it was organized is like a wall towards the outside, everything is closed except for the entrances... and the inside public space is the courtyard for the kids to enjoy [...] and the way it is organized is that this was the great patio, the great organizer of the children's activities [...] (IP-B2)

Most schools are gated for security reasons. In some cases, the school entrance is part of the perimeter gate or wall (School B), while in others, the building entrance is located inside the gated area (School C) (Figure 7-39). Also, the administrative office, which is the main contact between the school and community, is located close to the entry: “On the public side, this serves a security function and on the student side, it serves a supervision function where office staff can monitor students engaged in collaborative work or social activities and play” (Fielding Nair International, 2010b: 59).



School A



School C

Figure 7-39: Gates and entrance designs.

However, additional or alternate design strategies were considered to target school's security issues such as vandalism inside the school environment. In IP-J1's view, expression walls could be provided so that students can express themselves in designated areas. For example, this strategy could be useful for the development of proposed credits such as *The building makes people feel a sense of belonging and rootedness* to motivate students to keep their environment clean:

We can still work with that part of security so that they feel less attracted to doing that type of... and that they feel that identity... that it is mine... if you feel that something is yours, then you do not want to damage it. [...] At a given moment we said: "Look, we're going to make an expression wall." If they want to draw graffiti, they can do it, but we are going to design it [...] so that they can express themselves. And it no longer looks like vandalism, but rather it is part of the space, places that the students themselves can create. And it goes with the theme and the culture of the age basically to try to create that [...] it is possible that the vandalism problem may be solved that way (IP-J1).

Furthermore, she believes that students should be involved in the school clean-up and maintenance to encourage a sense of responsibility:

[...] perhaps the students should be part of the school maintenance. And I think that... because it's not necessarily that you're going to punish the student, but that there are rotating shifts. "X" classroom has to clean this day or this week and maybe you promote that by having to clean it you will not damage it (IP-J1).

Participants also commented on how their school design may impact user behaviour. For example, zoning became an important element to separate public and private areas, as well as school levels to prevent bullying or conflict between students in different age groups (IP-A1,C1). This strategy was employed both horizontally, on

one story schools, and vertically on multi-storey buildings. For example, elementary student facilities were located on the first floor, while middle or high school students' facilities were placed on the upper levels. Similarly, it was important to maximize visibility of gathering areas and avoid blind spots to maintain control over children behaviour (IP-A1). This is in line with theorist Juhanni Pallasmaa's view on architecture (2012: 68):

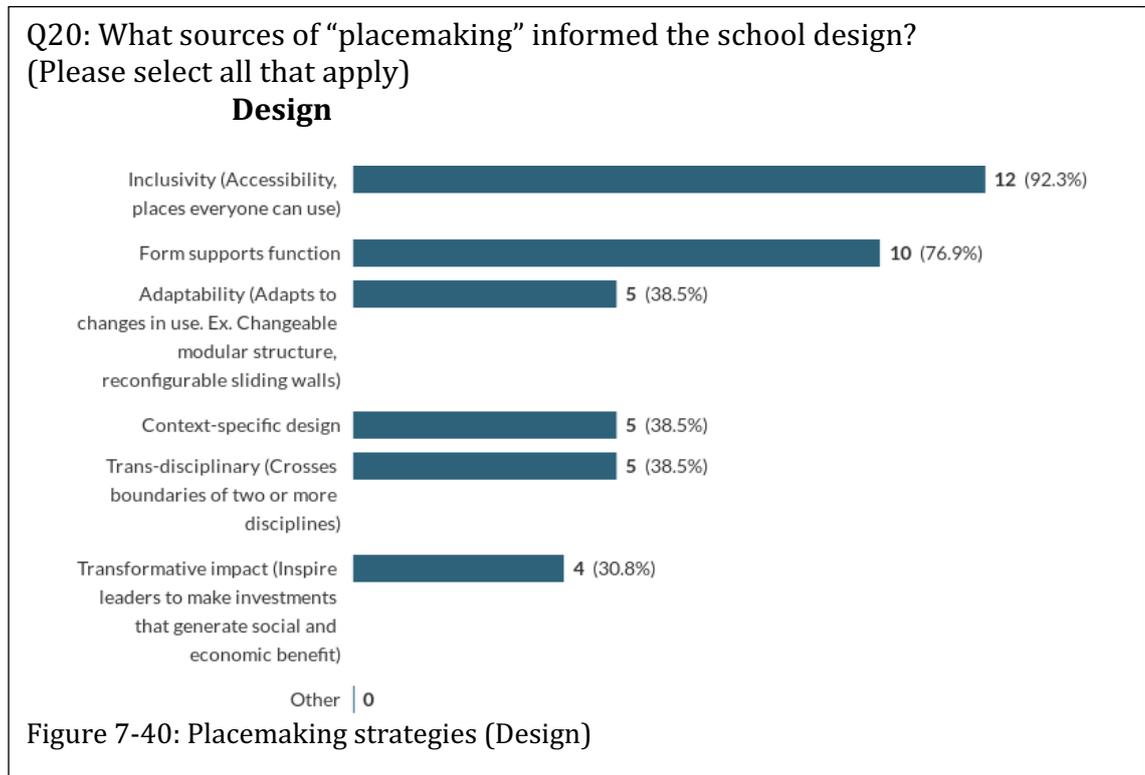
A building is encountered; it is approached, confronted, related to one's body, moved through, utilized as a condition for other things. Architecture initiates, directs and organizes behaviour and movement. A building is not an end in itself; it frames, articulates, structures, gives significance, relates, separates and unites, facilitates and prohibits.

Besides the physical security, IP-C1 highlighted the importance of the "feeling" of protection and how architecture may become a shelter for students:

[...] the feeling that you are in a protected place or a place that welcomes you, that is what is important. It is a difficult feeling to describe, but there are spaces where one does not feel well, one arrives and feels uncomfortable and cannot orient yourself. Children studying here need security, clarity and stability. [...] I understand that children live in a confusing environment where they have too much going on at the same time and I believe that this school should provide a safe environment and that the architecture should offer tranquillity, places where they can study and shelter from the rain and from the sun.

The strategies employed in local schools are in line with Oscar Newman's Defensible Space (1972) postulates, as evidenced in the professionals' survey and interview responses mentioned above. Considering schools are part of a community, and a community itself, both architecture and its inhabitants play a crucial part in increasing or reducing criminality, vandalism and theft. Giving the user control or personal responsibility of their own areas promotes crime prevention and neighbourhood safety. According to Newman's theories, an area is safer when people feel a sense of ownership and responsibility for their community (1972). Professional strategies employed in local schools can be mainly related to the following factors that make a defensible space: natural surveillance or the ability to promote visibility of areas, as well as Image or the ability to provide a feeling of security in its users. These strategies also informed the development of the indicator

Impact of the school design on the existing townscape or landscape (29.1) discussed in Chapter 8.



In addition to employing architectural strategies so that users feel welcomed, safe and secure, Architects and Sustainability Consultants highlighted the importance of Inclusivity (92.3%) and Form supports function (76.9%) under the **Design** category (Figure 7-40). Participants identified Accessibility as part of the school program requirements. In compliance with the American with Disabilities Act (ADA) (1990), that prohibits discrimination against people with disabilities in public places, designers must follow ADA Standards for Accessible Design (Department of Justice, 2010) and other universal design best practices. All the school spaces had to be accessible, for everyone to use and enjoy. While some schools included elevators (Schools A,D), others utilized open ramps for vertical circulation (School B). IP-D1, in particular, commented that one of the Schools his firm designed won the International Cemex Award for Accessibility for the way the ramp and interior courtyard were integrated. Other school programmatic requirements went beyond the norm and included specialized facilities for students with functional diversity (School B, J). Even though School J was not one of the five (5) in-depth case study

schools, it is important to point out that it had a small apartment where students with Down Syndrome were taught how to become independent. IP-J1 commented:

[...] it was very interesting to have it as part of the program and [...] not only to give a special service, because I think it is something very necessary and especially in our culture, that there is so much need.

In terms of form and function, spaces were designed for people to operate within them while providing adaptability, flexibility and variety (IP-B1, Fielding Nair International, 2010b: 66). This PM component may inform the *adaptive reuse* proposed credit considering School A, for example, incorporated a modular design using a pre-fabricated construction to promote adaptability and allow certain changes over the years. By completely freeing the interior façade from the columns, it is easier to modify it, if needed. In fact, 90% of this school is prefabricated, including the façade panels, the columns, some beams and walls while also allowing for rapid construction. Most classroom wall partitions in this school were made using concrete blocks that are not part of the load bearing structural system. This allows certain flexibility in case they had to eventually remove walls to combine rooms into larger spaces. Similarly, aluminium sliding doors were installed in adjoining classrooms to promote different dynamics of education (IP-A1). Likewise, School E buildings or pavilions had few interior partitions to create a flexible layout (IP-E1). The Schools for the 21st century program also required the provision of DaVinci rooms to provide variety and allow students work on science and art projects using the same space. Figure 7-41 summarizes the Placemaking strategies previously discussed and employed in local schools that will inform the development of cultural indicators for the local context.

Furthermore, Table 7-4 presents an alignment between proposed LEED indicators and applicable Placemaking strategies that could inform its development. Both the Sociability and Participation, as well as the Uses and Activities categories impact the larger number of indicators. This further emphasizes the importance of the socio-cultural component in the proposed credits.

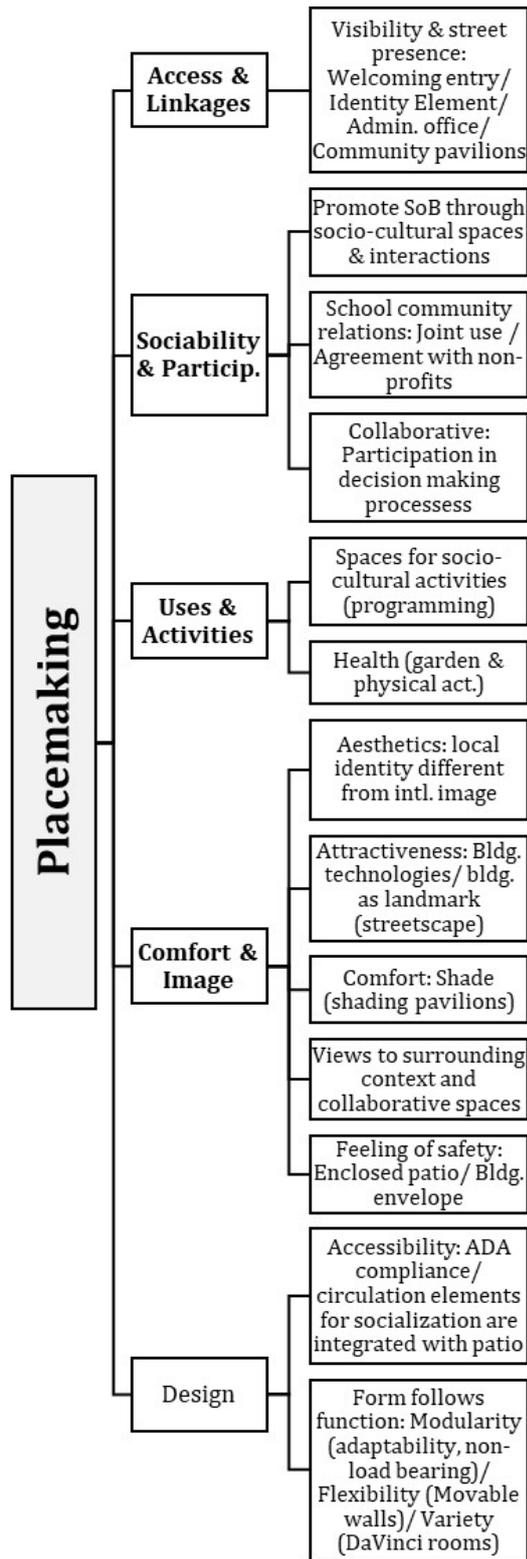


Figure 7-41: Placemaking strategies employed in local schools

Indicators (abbreviated)	Placemaking categories				
	Access & Linkages	Sociability & Participation	Uses & Act.	Comfort & Image	Design
Cultural Spaces and Events					
31.1. Cultural Diversity					
31.3. The building has spaces for cultural activities.					
31.4. Provide a space for communal meals.					
31.5. Open Space					
31.6. Joint Use of Facilities					
31.9. The building makes people feel a sense of place, belongingness and rootedness.					
31.11. Learning environments and school culture foster creativity and innovation.					
31.13. Aesthetic quality of the building					
31.14. Neighborhood Facilities					
Cultural Heritage					
29.1. Impact of the school design on existing streetscapes.					
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes					
29.4. Raise awareness of the building's heritage value					
Education					
28.4. Afterschool arts and cultural programs					
# of indicators impacted	6	7	8	5	5
% of indicators impacted (n=13)	46.2%	53.8%	61.5%	34.5%	34.5%

Table 7-4: Alignment between proposed LEED indicators and applicable Placemaking strategies that could inform its development. Both the Sociability and Participation, as well as the Uses and Activities categories impact the largest number of indicators. This further emphasizes the importance of the socio-cultural component in the proposed credits.

7.5. Conclusions

This chapter focused on Phase 3 research findings, which included a survey and semi-structured interviews to design and construction professionals of LEED certified case study schools. Following the Conceived Space Findings and Discussion diagram in Figure 7-10, and employing a mixed methods analysis, we explored professional's

experience with LEED, including level of satisfaction and adequacy. While most professionals were moderately satisfied (52.2%) with the LEED certification process of their schools, a 47.8% believes the system is not adequate for measuring the local context, citing economic, bureaucracy and climatic differences. Also, professional's perception coincided with the International Comparison of SAS results, in which they believed that LEED mostly targets environmental issues while other sustainability dimensions such as the cultural one, lag behind. With the intention of strengthening this dimension and creating a more balanced SAS, this chapter also explained the methodology employed to select the final list of thirteen (13) cultural indicators considered as priority for the local context, based on professionals' input on the survey.

We also explored design intention and building use based on participant's cultural identity meaning. We discussed the cultural values and influences that informed the selection and disposition of forms, including influences and sources of inspiration. The discussion included the impact of styles such as modernism, tropical architecture and their evolution into what has been denominated as "tropical sustainable architecture" (Bay and Ong, 2006). Inspired by both local and external influences, designers also referenced 20th century architects and projects, as well as more recent LEED certified schools in the U.S. This myriad of influences combined with local cultural referents led to the development of a hybrid style as P.R. identity.

Throughout the analysis, it was also evident the connection between specific architectural mechanism elements (spatial organization and physical structure) employed in case study schools and placemaking strategies that define the building's cultural expression. The survey and interviews served to delineate a cultural identity profile of local schools in P.R. that allowed us to identify several aspects of sustainability in the tropical Caribbean P.R. region that could be incorporated as indicators (**RO3**). Incorporating PM strategies to the proposed LEED credits and the revision of existing ones intends to promote user engagement and sense of belonging in local schools. In the next chapter, we will align architectural and Placemaking strategies with its corresponding LEED credit. This, in addition to results from Phase

4 interviews to sustainability consultants and mechanical engineers, will inform the development and adaptation of proposed indicators to the local context.

Chapter 8: Cultural Indicators

8.1. Introduction

This chapter will focus on analysing research findings from Phase 4 semi-structured interviews to sustainability consultants and mechanical engineers to inform the revision of existing LEED credits and proposal of new cultural sustainability indicators adapted for the local context (**RO5**). Figure 8-1 presents an excerpt from the methodological framework, that illustrates the qualitative research techniques employed on this phase.

Phase 4	Semi-structured Interviews: LEED AP's & Mechanical Engineers (n=9) ▼ Thematic analysis: •Validate and further develop proposed cultural indicators	QUAL.
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Figure 8-1: Phase 4 Research Techniques, excerpt from the Methodological Framework (by author).

Section 8.2 will expand on the research methodology employed on phase 4, explaining the recruitment strategy, outlining the participant profile and describing the research instruments. Section 8.3 will explain how the thematic analysis was carried out, followed by recommendations for LEED existing indicators and proposed Pilot Credits, organized under Cultural Vitality categories in 8.4. These recommendations have informed the booklet presented on Appendix X, titled *LEED Cultural Sustainability Credit Guide*, which will be useful for disseminating the findings of this study. Furthermore, additional themes for indicators proposed by participants during the interviews will be discussed in section 8.5 and explain how these were integrated into the proposed indicators or may be considered as further research. Finally, conclusions for this chapter will be presented in 8.6.

8.2. Research Methodology [Phase 4]: Semi-structured Interviews [LEED AP's and Mechanical Engineers]

After analysing the data collected on Phase 3, it seemed appropriate to convene an online focus group to further develop the LEED cultural indicators identified as priorities on the survey. Originally, a Focus Group (FG) with the LEED AP's of Record was organized to further develop the preliminary list of cultural indicators for the P.R. context. It is important to point out that the Focus Group was organized as an online event due to COVID-19 restrictions that were in force in November 2020 by the government to prevent the spread of the virus. The initial target population included the five (5) professionals, who participated in the LEED certification process of the eight (8) schools in the mainland selected as case studies.

Morgan and Scannell (1998: 73) recommend smaller groups of less than six (6) persons, when participants are likely to have a lot to say on the topic or in this case, where all thirteen (13) indicators were to be discussed with the participants. Even though three (3) professionals confirmed their participation, only two (2) were able to attend. Considering the limited number of participants and specificity of the target population, the format was adapted and carried out as a Joint-Interview instead. Paired in-depth interviews work better when the two interviewees already have a pre-established relationship such as co-workers or colleagues (Morris, 2001). In this research, both participants were architects and sustainability consultants in the design industry. The researcher interviewed both participants to collect information about how the pair perceived the same event or phenomenon (Wilson et al., 2016: 1551).

In the end, joint interviewing helped to establish rapport and an atmosphere of confidence; revealed the different kinds of knowledge held by each person; and produced more complete data as interviewees fill in each other's gaps (Wilson et al., 2016: 1554). The discussion demonstrated broad agreement between the participants in most indicators, particularly those concerning community participation in the decision-making process, but also each had the opportunity to talk about their own experiences in the schools they had worked on. Even though it

was a joint-interview it lasted approximately 130 minutes, while FG typically last 60-90 minutes, giving both participants enough time to express their point of view (CDC, 2018).

After a preliminary analysis of the information gathered, additional individual online semi-structured interviews with LEED AP's were carried out so that indicators could be discussed in depth with each of the participants. Out of ten (10) participants that were invited, a total of seven (7) LEED AP's participated in the above-mentioned joint and individual semi-interviews, which included a similar structure, questions and format. Additionally, semi-structured interviews to two (2) mechanical engineers were performed to delve into participants responses regarding the use of passive strategies in LEED certified schools.

There was representation of professionals from all LEED certified schools in P.R., considering that several interviewees participated in more than one school. The final number of participants was determined by continuing the interviewing process until theoretical saturation was achieved (Glaser and Strauss, 1967: 61). At this point, comments and patterns began to repeat and little new material was generated (Bryman 2012: 420).

8.2.1. Recruitment Strategy

Sustainability consultants were initially contacted by telephone. In this conversation, the research investigator briefly explained the joint or individual interview dynamic and asked them if they might be interested in participating. The research investigator emailed them the Informed Consent Form. The principal investigator also sent an RSVP form and questions by email so that participants could review them beforehand (Appendix S). Five (5) to seven (7) days, after the initial contact, a reminder message was sent to the professionals who had not yet confirmed their participation. Also, an event reminder was sent to all confirmed participants the day before the meeting.

Before beginning the joint or individual semi-structured interviews, the researcher shared the Consent Form on screen (Appendix T). This document was discussed and

any questions they had were answered. Participants were asked to confirm their consent on the MS Teams chat tool by writing “agree”. Participants who did not agree were allowed to leave the meeting without penalty, even though no one chose to do so. The main researcher took a screenshot of the chat tool as evidence of participant’s consent. Participants were allowed to cancel their consent before the date specified on the Consent Form.

8.2.2. Participant Profile: 2nd Round of Interviews

As shown in Figure 8-2, the second round of interviews (Phase 4) was carried out with a total of (9) participants, seven (7) sustainability consultants and two (2) mechanical engineers, representing all ten (10) LEED certified schools in P.R. It was enriching for the thesis that the participant sample for the second round of interviews was more diverse than the first one, where only architects were interviewed to focus on design intention, as described on Chapter 7. Even though all seven (7) professionals were LEED AP’s, they had different roles during the design and construction process, such as a government representative; project architect; project manager and a commissioning agent. The input from certified professionals with diverse responsibilities during the design, construction and certification process resulted in valuable insight for the development of new LEED indicators and proposed revisions to existing ones.

The majority of participants on this round were female (77.8%) and LEED certified (77.8%). When analyzing the participant profile on phases 3 and 4, there was representation from both genders. As discussed on chapter 7, on the survey and first round of interviews the majority were male. This may represent that the construction sector is male dominated. Participant selection for the second round of interviews was based on the profession and role in the project, giving priority to sustainability consultants and mechanical engineers. However, most sustainability consultants for the schools for the 21st century project were female and engineers were male. In the future, I would try to reach more people to obtain a more diverse sample within each phase. Most LEED AP’s had from eleven (11) to fifteen (15) years of experience (57.1%) and had certified one (1) to five (5) projects (44.4%).

However, those professionals that were not LEED certified were USGBC members at the time the schools were built (2013-16).

For confidentiality reasons, each school was randomly assigned a capital letter. Throughout this investigation, Interview participants (IP) or Questionnaire Participants (QP) will be identified with the letter that represents the school name and a number next to it. For example, the code IP-A3, will be used when quoting the Interview Participant from School A, identified as number 3.

Interviews (2nd Round): Participant Profile

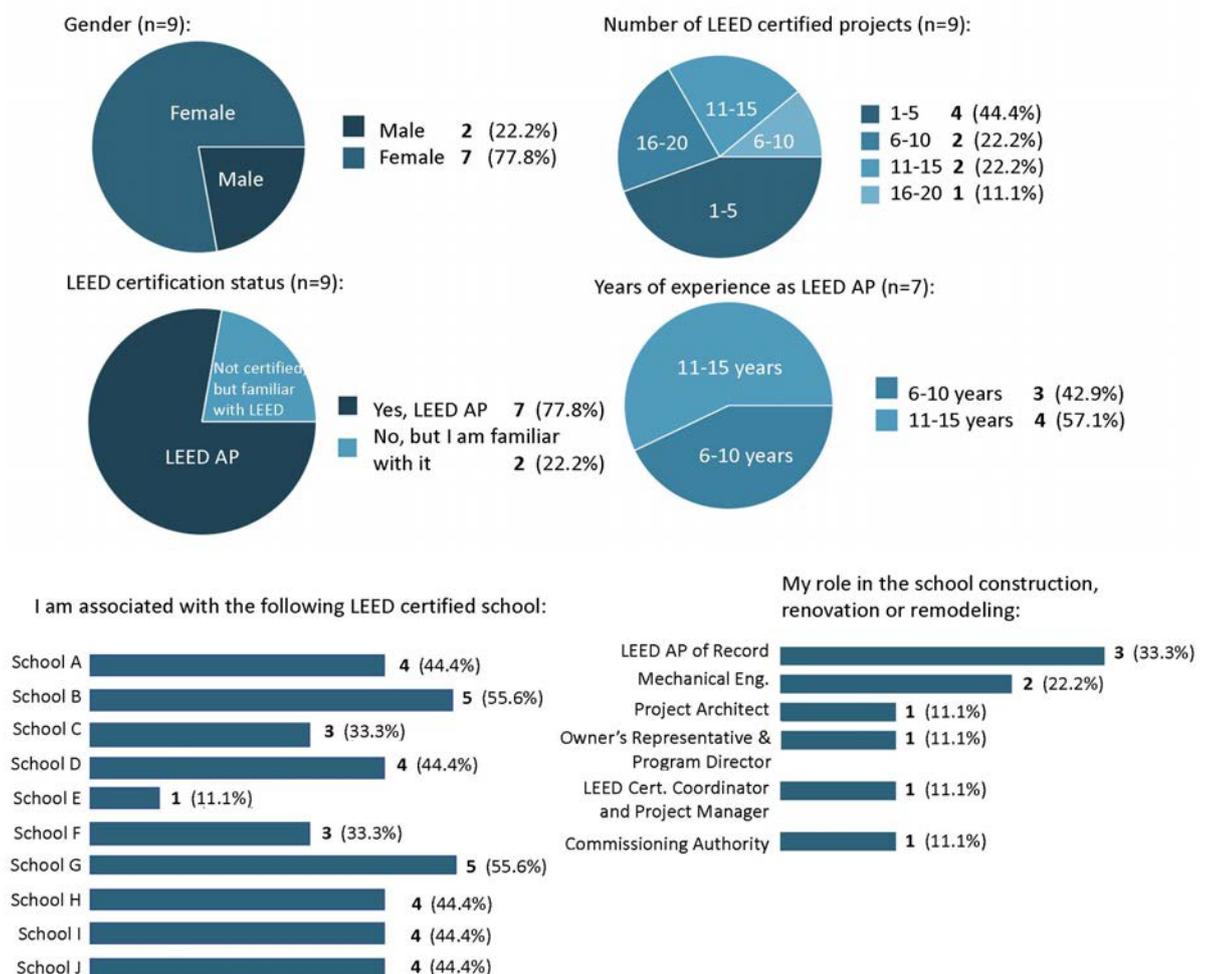


Figure 8-2: 2nd round of Interviews- LEED AP's/ Mechanical Engineers participant profile (n=9)

8.2.3. Research Instruments

Interview questions asked professionals to indicate which strategies and documentation requirements they would propose for the selected LEED pilot credits and which recommendations would they suggest to strengthen the cultural component in existing credits. A table per credit was shared on screen and filled by the main researcher during the meeting to include a summary of participant's recommendations. This also served as a data validation strategy to confirm the main researcher correctly understood the participant's viewpoint. In addition, the meeting was audio recorded and a transcription was generated to facilitate the qualitative analysis process.

The design of Table 4 in Appendix U was informed by the LEED Pilot Credit Application Form (USGBC, 2022f), and included the following: credit name, credit requirements and documentation requirements, as well as a thematic analysis from SAS indicators worldwide and Phase 3 interviews. This way professionals can submit the form directly to the USGBC in order to use the PC on their projects. In order to ensure that credits are adapted for the local context, Interviewees were asked to indicate:

- Would you have attempted this indicator as a pilot credit under the Innovation category to certify your 21st century school project as Building Design and Construction (BD+C) and what implementation strategy and documentation requirements would you propose?
- If you were to re-certify your 21st century school project(s) under LEED Operations and Maintenance (O+M), would you have used the following pilot credit and what implementation strategy and documentation requirements would you propose?
- Can you identify which of the following credit and documentation requirements in the thematic analysis of SAS worldwide apply to the P.R. school context?

Note that participants had to indicate if each credit was applicable for their school and if they would use the indicator for New Construction or Operations and Maintenance phase. Later, the information gathered was combined into a single table with all of participant's input, as shown in Appendix V. The completed table served

as a tool to visualize which indicators were relevant for each case study and further develop the proposed credits.

Interviews with mechanical engineers were meant to validate and/or clarify participants responses on the survey, stating that LEED guidelines fall short to incentivize passive design strategies, which have been typically used as part of the traditional architectural typology of the tropical region and have demonstrated their effectiveness in the reduction of energy consumption (QP-E2, H1). These two (2) professionals were responsible for demonstrating adequate building systems performance and developing energy models in their particular schools. As shown on Appendix W, questions were meant to explore if passive design strategies contributed to better achieve or diffculted compliance with LEED's energy performance indicator requirements and what strategies did they employ to earn these credits in naturally ventilated local school buildings. While their responses informed passive design strategies included in the proposed cultural credits, additional energy and design credits could be developed or revised as further research.

8.3. Thematic Analysis

The qualitative thematic analysis for Phase 4 findings was done using the NVivo computer software to analyse interview transcripts, extract relevant participant quotes and classify them based on preliminary nodes or themes aligned with the Conceptual Framework. The program served as a place to store all the information gathered in the different phases and cross-examine data to discover connections between the information gathered, which would have been overwhelming if done manually particularly considering phases were carried out sequentially and in different timeframes.

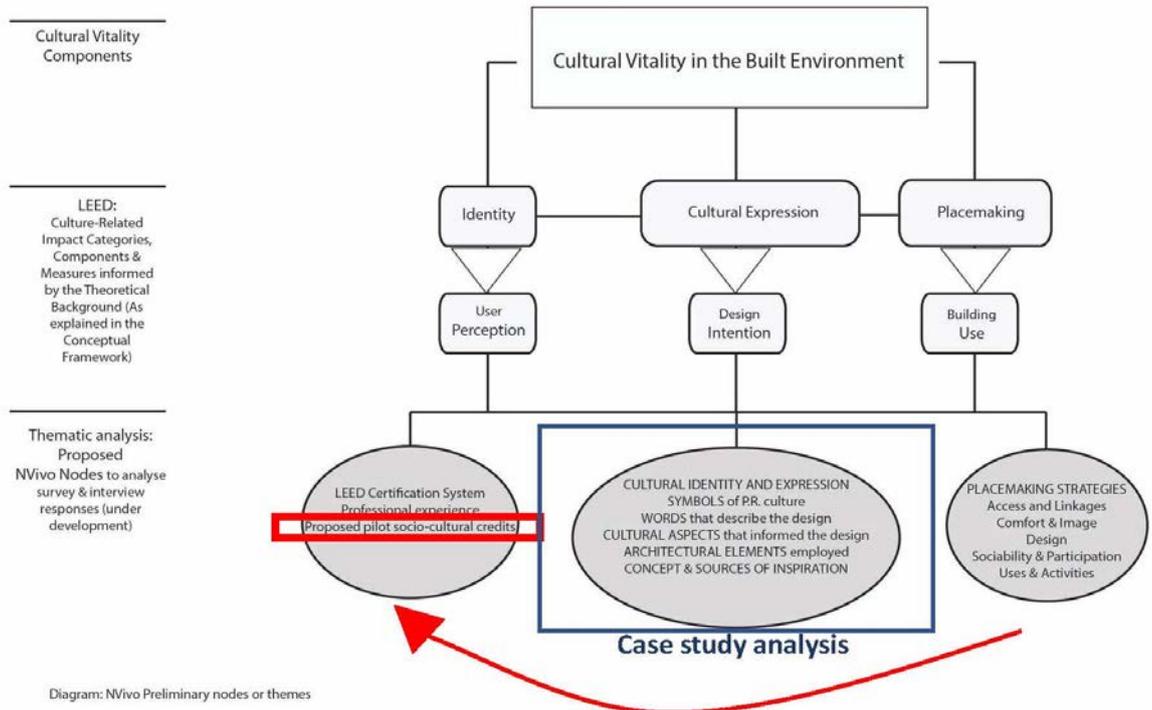


Figure 8-3: Qualitative Thematic Analysis: NVivo nodes aligned with the conceptual framework

Figure 8-3 illustrates a variation on the Conceptual Framework diagram to explain that proposed cultural credits will also be informed by results from the survey and interviews in Phase 3, particularly those relating to Cultural identity and expression and Placemaking strategies employed in case studies and discussed on the previous chapter.

Once all the data was uploaded to NVivo, nodes were created based on the information required on the LEED Pilot Credit Application Form (USGBC, 2022f). As shown in Figure 8-4, each proposed credit was created as an individual node and relevant participant quotes were placed underneath in child nodes or subfolders, namely: Background information that will help justify the credit, Requirements, Documentation Requirements and information from case study schools that may inform the credit.

This image has been removed by author for copyright reasons. Original image available at: <https://usgbc.wufoo.com/forms/usgbc-member-pilot-credit-proposal/>

Qualitative thematic analysis:
Format used as reference for
organizing NVivo nodes

Name	Files	Referen
Z_NEW_LEED proposed credits	0	0
Cultural spaces and events	17	267
Aesthetic quality	12	39
Communal meals	13	30
Creativity and innovation	14	55
Cultural diversity	8	20
Joint Use of Facilities (EC)	9	25
Neighborhood Facilities	8	13
Open Space (EC)	3	10
1_Background info_Justification	7	14
2_Requirements	1	1
3_Documentation Requirements	3	3
4_Case studies	0	0
Sense of place, belongingness and rootedness	13	53
Spaces for cultural activities	1	4
Education	1	1
Heritage & Adaptive Reuse	2	4

Figure 8-4: Alignment between Pilot Credit Application Form (USGBC) and NVivo nodes

Sample coding process- Open Space (LEED existing credit)

Phase 1: Terms (nodes) based on participant’s language (Interpretive)

Phase 2a: Combination of predetermined and emerging codes (Cresswell 2009). Nodes categorized under PM strategies and named as follows: PM strategy_term based on participant’s language.

Phase 2b: Nodes further refined and grouped with similar themes

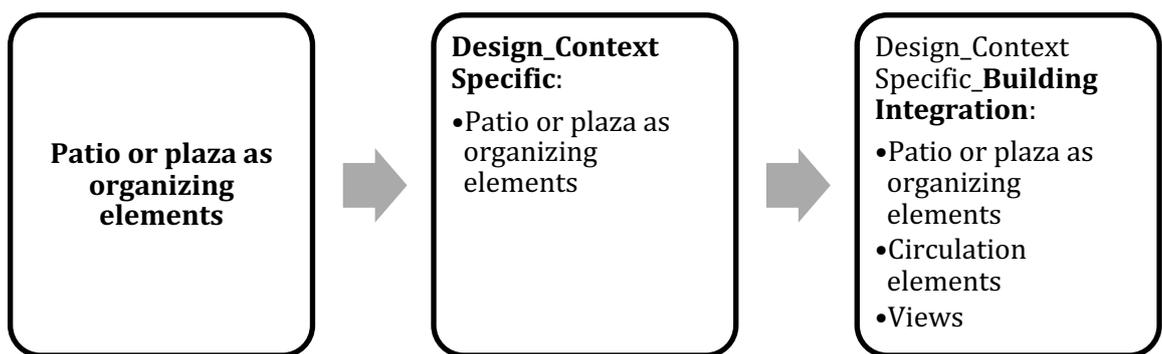


Figure 8-5: Open Space LEED existing credit sample coding process using NVivo includes the application of Placemaking (PM) strategies to LEED requirements. These nodes/ themes will translate into strategies or requirements that professionals have to comply to earn the proposed credit.

The coding process was done in two (2) main phases, as shown in Figure 8-5. During the 1st phase, professional's responses were coded using emerging themes based on the participant's language, as aligned with the interpretive paradigm and Watts (2014) methodology for qualitative data analysis. For example, the analysis revealed that existing credit requirements for the *Open Space* credit are rather general and vague. Therefore, the research sought to identify with more specificity what open space means for the P.R. cultural identity and architectural tradition. During the interviews, participants mentioned that patios have a very important role in the configuration and organization of the floor plan within P.R.'s architectural tradition (IP-A2,C1). These organizing elements are typically defined by building walls and, oftentimes, by open hallways that serve as transition between exterior and interior spaces. In this sense, supporting information related to this topic was coded under the "Patio or plaza as organizing elements" node.

The right image in Figure 8-4 shows the 2nd coding phase in which predetermined and emerging codes (Creswell, 2009) were combined by applying Placemaking (PM) strategies to the proposed LEED requirements. The node was renamed by including the applicable PM strategy next to the term based on participant's responses. In this case, the node was labelled as follows: "Design_Context Specific_Patio or plaza as organizing elements". Note that the left part of the label is the predetermined PM strategy while to the right is the emerging theme based on participant's responses. This theme was further classified and grouped under "building integration", with similar nodes, including views and circulation elements, that describe the visual or physical connection between the open space and surrounding buildings. This will translate into strategies that professionals have to comply with to earn the revised credit. While Figure 8-5 illustrates a sample of NVivo coding nodes, credit 31.5 in the brochure (Appendix X) shows the proposed credit requirements that were developed based on the analysis of the information gathered.

8.4. Recommendations for LEED Existing Credits and Proposed Pilot Credits

As stated in the implementation proposal in Chapter 2 (section 2.3), Pilot Credits in the Innovation category could be a starting point to test the proposed indicators product from this research. Once these credits are tested and approved by the USGBC, they become part of the online Pilot Credit Library, which contains all the pre-approved PC available for professionals to use in their projects. While the original intention of this research was to submit the proposed Pilot Credits directly to the USGBC, these may only be submitted by USGBC member organizations by filling out the application form included in Figure 8-4 (USGBC, 2017). Considering that the main researcher is not part of or does not work for a member organization presents a limit to the initial dissemination strategy of the research. However, LEED's ongoing Call for Ideas presents an alternative to submit the research findings presented in this thesis for consideration of LEED Committees and Technical Advisory Groups. These proposals may inform future versions of LEED (Hughes, 2021). For this reason, proposed credits and revisions to existing ones will be sent directly to the USGBC by using this method and filing out the form available on their website.

Furthermore, the main researcher will make the arrangements to present the proposed LEED credits resulting from this thesis to the USGBC P.R. chapter and the USGBC Florida Caribbean Regional Committee. These indicators will also be available in a booklet titled *LEED Cultural Sustainability Credit Guide* (Appendix X) for professionals that may want to submit the credit as part of their project's certification process. The booklet will include the necessary information for professionals to fill out and submit the PC form. Revisions to the existing credits are included as addendums, considering the USGBC requires that these proposals are expressed as actual edits to the existing LEED language (Hughes, 2020).

While this chapter presents the data analysis, participants recommendations, supporting documentation and theories that justify the final credit requirements, the booklet on Appendix X serves as companion or guide and presents the proposed credits utilizing LEED's format and language. The *LEED Cultural Sustainability Credit*

Guide details the documentation requirements that would need to be submitted to earn the credit, accompanied by applicable technical information to ensure that these indicators are related to the P.R. context. This guide also includes proposed qualitative and quantitative metrics for the new and revised LEED indicators. Throughout this research I observed the necessity for providing metrics, particularly for qualitative aspects, so that green initiatives may be documented adequately by project teams and evaluated by the GBCI.

The booklet was inspired by the USGBC Safety First COVID-19 Response Credit Guide (USGBC, 2021c), which includes a series of Pilot Credits developed for building re-entry and operations after the pandemic. It is also important to point out that inspired by LEED Reli (USGBC, 2020a), the Sociability and Participation PM strategy, the LEED- ND Innovation credit: Community Outreach and Involvement (USGBC, 2022c), and participant's input, each applicable credit includes a section on community requirements. Further complemented by documentation from The New European Bauhaus that advocates for citizen engagement and co-design practices (European Commission, 2022). This is further justified by participant's emphasis on the importance of community involvement to promote a sense of pride and ownership in schools, encourage school and community relations and full participation in decision making processes.

As previously indicated on Chapter 7, proposed indicators were classified into the following seven (7) cultural vitality categories for participants to prioritize: Cultural Communication; Economy; Governance, Heritage; Cultural Inclusion and Participation; Education; and Cultural Spaces. However, only indicators on the last three categories were selected as most important for the local context by participants on the survey. On this section, we will expand on these cultural vitality categories and selected indicators. Also, look at Placemaking strategies that could be incorporated on each credit based on the case study analysis in Chapter 7 and participant responses.

This chapter will first examine revisions to existing credits, followed by proposed indicators. Some credits will also be grouped based on credit synergies. For the LEED system, this means that some credits relate to each other, and the strategies

employed in one can help you earn another. The total of thirteen (13) indicators selected from the survey was reduced to eleven (11) considering, oftentimes, the analysis pointed to credits that could be merged and/or specialized by themes, as will be discussed. Five (5) existing indicators were revised, while six (6) were new. Most indicators belong to the Cultural Spaces and Events category (63.6%), followed by Cultural Heritage (27.3%) and Education (9.1%).

8.4.1. Cultural Spaces and Events

Indicators under the Cultural Spaces and Events Cultural Vitality Component selected by professionals promote the availability of spaces for cultural activities, social exchange, and recreation, as well as interaction with the environment. Also, foster the provision of spaces and learning environments that foster innovation, creativity, and sense of place. Table 8-1 includes the final list of selected credits for the Cultural Spaces and Events Category. Each credit has the survey item number next to it, which was kept for reference purposes.

Table 8-1: Cultural Spaces and Events Category Proposed Cultural Indicators	New Credit	Existing Credit
31.5. Open Space		X
31.6. Joint Use of Facilities		X
31.3. The building has spaces for cultural activities (To be merged with #31.6)		
31.1. Cultural Diversity (To be merged with #31.6 and 31.9)		
31.14. Neighborhood Facilities (Surrounding Density & Diverse Uses)		X
31.4. Provide a space for communal meals	X	
31.9. The building makes people feel a sense of place, belongingness, and rootedness (School Community Sense of Belonging)	X	
31.11. Learning environments and school culture foster creativity and innovation	X	
31.13. Aesthetic quality of the building	X	

Table 8-1: Cultural Spaces and Events Indicators

31.5. Open Space

During the initial stages of the Schools for the 21st Century project, the FNI evaluation team performed several visits to existing local schools. The report

identified that even though the interior courtyard was part of the typical Puerto Rico school prototype, outdoor areas were poorly maintained, underutilized and classrooms lacked windows overlooking these spaces (Fielding Nair International, 2010: 24). One of the Schools for the 21st Century program strategies was to strengthen the connection between indoors and outdoors by maximizing views and providing open play areas that foster children’s social and emotional development, while taking advantage of the local tropical climate.

Using interior patios as part of the organizational scheme became one of the main strategies employed by case study schools to earn the *Site development - maximize open space* credit (SSc5.2) which was its title in LEED v3. While eight (8) out of nine (9) certified schools in P.R. earned the credit, six (6) of these obtained an additional Regional Priority bonus point because this indicator was listed as important for the project’s location (USGBC, 2022).

However, when local schools were certified, the credit’s intent was to “promote biodiversity by providing a high ratio of open space to development footprint” (USGBC, 2009b). One of the positive aspects from LEED version 4’s revision is that in addition to promoting habitat preservation, teams must “create exterior space that encourages interaction with the environment, social interaction, passive recreation, and physical activities” (USGBC, 2022d). However, the credit’s intent would benefit from replacing “social interaction” with “socio-cultural exchange” to strengthen its cultural sustainability component. Furthermore, it is important to point out that open spaces must be compatible with local cultural values and practices as indicated in similar SAS such as SBTool (iiSBE, 2009). The revised intent would read:

To create exterior space **compatible with local cultural values and practices** that encourages interaction with the environment, **socio-cultural exchange**, passive recreation, and physical activities.

To earn this LEED indicator, teams currently must demonstrate compliance with the following criteria:

- Provide an outdoor space greater than or equal to 30% of the total site area, out of which 25% must be vegetated or have a vegetated canopy.

- Comply with one (1) or more of the following:
 - social area: a pedestrian-oriented paving or landscape area that accommodates outdoor social activities
 - recreational area with paving or landscape that encourages physical activity
 - diverse green space
 - garden space dedicated to community gardens or urban food production
 - preserved or created habitat that also includes elements of human interaction (USGBC, 2022d)

To strengthen this credit's cultural component, revised credit requirements would read: "social area: provide a pedestrian- oriented paving or landscape area adequate for outdoor socio-cultural activities". For example, areas with hard pavement could be used for the exhibition of student sculptures or other art projects (IP-E1, J1). Also, outdoor amphitheatres could serve for music concerts, plays, lectures, among other events (Schools A,C,D).

It is important to point out that case study schools earned this credit through the provision of interior patios and/or green roofs. As explained in Chapter 7, interior patios have been used as part of the architectural school typology of the region, making this credit's application context specific. These open spaces also served as an organization tool for the building layout, while also facilitating opportunities for socialization.

During the interviews, sustainability consultants highlighted the importance of adding supplementary credit requirements for project teams to comply with including **climatic considerations** such as the provision of protection from the sun and rain through trees, vegetation, canopies and/ or gazebos, among others (IP-J1). According to IP-J1, the functionality of open spaces is very important considering the Island's hot and humid climate:

... although we love open spaces it can get very hot... and then how do we design that space, maybe adding some vegetation... but obviously vegetation requires some maintenance. I think there must be a balance between what nature is and designing these shaded, cool spaces. It is necessary. I recently went to a new public school and it was hot and they had a very nice indoor playground, but horrible sun. I said "no one will use this patio" because everyone was hiding behind the columns because there weren't any trees

inside the patio, there wasn't any roof. They had a very nice interior patio, very large, but no one can stand there at noon.

Following recommendations on the Auckland Council design manual (2022), open space location, orientation, scale, shape and proportion must also be considered to maximize shade and natural ventilation. While Auckland has a sub-tropical climate, its summers are also considered hot and humid, similar to P.R. Applicable strategies on this manual were used as reference considering they have already been approved and implemented in similar climatic contexts.

Participants also highlighted the importance of the **building's integration with the existing site topography** in the design of open spaces. For example, sloped terrains were used in case study schools to create terraces or bleachers, similar to an amphitheatre (Schools C, D). This may limit the need to cut and fill the terrain while also providing socialization spaces. Open spaces must also be **integrated to the building** program, circulation, and its surrounding structures to make sure that these “are not left out in a corner back there only to comply with the required percentage” (IP-I1). Some strategies might include, but are not limited to, (1) the use of outdoor courtyards as an organizational tool in the floorplan; (2) the provision of transition spaces and elements between the exterior and interior areas such as open corridors, eaves, among others (IP-B2); (3) the specification of doors that allow users to open the classroom and other areas to exterior spaces (IP-K1); and/or (4) maintaining important natural features and maximizing views within the site (Auckland Council, 2022, IP-C1,D1).

Additional recommendations to improve this LEED credit were provided by interview participants, and aligned with the Placemaking Categories Design, Sociability and Participation and Uses and Activities. As a result, in the revised credit, teams are required to provide open space programmatic areas that are accessible and follow universal design guidelines so that people regardless of age, disability or other factors can use them. For example, school I won the international Cemex award for providing accessibility to all people in the use of services, particularly for the way the interior courtyard, the ramp and the corridor were integrated (IP-D1). Bleachers

and vegetated terraces become collaboration spaces and integral to the design of the interior patio, which becomes the centre of events (Figure 8-6).



Figure 8-6: School I design integration and accessibility in the interior courtyard, the ramp and surrounding corridor (Images provided by participant).

Aligned with the Sociability and Participation PM strategy, teams are also required to employ participatory design methods so that the school community can inform about their programmatic needs and interests for the open space that will be provided. Teams should document and analyse participant's input and modify the design of the project's open spaces as a direct result, or if modifications are not made, explain why community input did not generate any alterations. Interview participant E2, believes that this will ensure that the credit is implemented correctly and that the community benefits from it:

This credit is very important, it has to be there. If I had to modify something [...] I would put the credit as part of the discussion of the participatory method... that the community can inform about what interests them in that space that is going to be offered to them. What are they going to gain from that and what are the uses that they think they need? [...] and I think this will ensure that the credit is implemented correctly and that they take advantage of the credit because it is a difficult credit to achieve because that is real estate... but the way you ensure that this real estate is in the best interest of the community is letting the community decide (IP-E2).

During the FNI community visioning workshop, one participant commented that he hoped for: “[...] a school where the environment is part of it with gardens and running water. Areas that promote healthy socialization, relaxation and the feeling of freedom” (Fielding Nair International, 2010: 37). This further validates the importance of open spaces for the community. Even though community members

participated early on in the project conception process, professionals commented that there could have been more community participation during the design process to further define the qualities of these spaces (IP-B1,C1).

In Puerto Rico, the importance of exterior learning spaces has, once again, proved its relevance particularly after recent emergencies. Natural lighting and exterior teaching spaces were crucial during the Hurricane María recovery process, when several schools had to reopen without electricity (Alvarez, 2017). Also, after the 2020 earthquake, particularly people living closest to the epicentre on the southern part of the Island, were scared to be in enclosed spaces because of the continued aftershocks. Schools were locked down for inspection and several people took refuge in temporary tents, oftentimes in improvised or inhospitable spaces. During this time, outdoor learning spaces were created in temporary shelters to bring activities to kids (IP-E2). Furthermore, during the COVID emergency (2020) schools were locked down for several months, and teaching was done remotely. Recent studies have demonstrated that the risk of COVID-19 transmission is lower outdoors, which is why several schools might have been able to undertake outdoors teaching-learning activities if equipped with adequate and consciously designed open spaces (Will, 2021).

In order to target participant concerns and FNI observations to ensure that open spaces are not remnants and are adequately designed to maximize their potential use, the revised credit requires teams to provide evidence that outdoor spaces are consciously designed for learning or as an extension of the indoor learning space, while also providing protection from the sun and rain (Fielding Nair International, 2010: 24). According to IP-A1:

The 21st century program had what they called the "shading pavilions" [...] a teacher can go under these structures that are protected from the sun to teach a class outside without necessarily having to sit on the floor under a tree, that is, I believe that there are little things that can be added but it is more about the importance that is given to these cultural interactions or how people can take advantage of our climate but also taking into account that it is not right

to design outdoor spaces without any type of protection because we do not live in a temperate climate country, [laughs] here it is hot.

Schools B and D, for example, incorporated shading pavilions as part of the interior patios. IP-B1 compared the shading pavilion to a bus shelter and commented that from day one, kids use it. Similarly, school D included a pavilion to provide shade to the stairs and steps (Figure 8-7).



Figure 8-7: Shading pavilions. Left: Gazebo on School B patio. Right: School D's gazebo over steps (Image provided by Participants).

31.6. Joint Use of Facilities

31.3. The building has spaces for cultural activities

31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.

During the interviews, it was discussed that the contents of both credits *The building has spaces for cultural activities* (#31.3) and *Cultural Diversity* (#31.1) could be merged with the *Joint Use of Facilities* LEED BD+C credit in the Sustainable Sites category. These indicators share common themes and joining them could serve to improve the cultural component of this existing indicator. Figure 8-8 summarizes the relationship between credit 31.6 and compatible indicators.

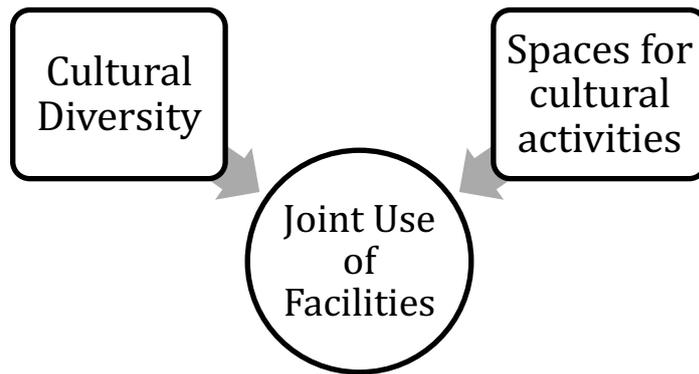


Figure 8-8: Integration of Spaces for cultural activities and Cultural Diversity criteria in the Joint Use of Facilities LEED existing credit

While the proposed credit 31.3 focuses on the availability of spaces for cultural activities, its merge with *Joint use* (31.6) seeks to maximize the potential and use of these venues by sharing them with the surrounding community. It is important to point out that the *Joint use* credit was attained by five (5) out of nine (9) case study schools in P.R. (55.6%), which also demonstrates its relevance for the local context. This credit aims to “integrate the school with the community by sharing the building and its playing fields for non-school events and functions” (USGBC, 2022g). To strengthen this indicator’s socio-cultural component, the research referenced compatible indicators in SAS worldwide, such as the UNESCO Culture for Development Indicators (United Nations, 2014: 70), that aim to promote egalitarian access to culture and cultural spaces. Public local schools could become a tool to provide cultural access to its users and their surrounding communities island wide. For this reason, the intent was revised to include the following statement: “Encourage user participation and socio-cultural exchange through the provision of spaces and programming strategies”.

To earn the current LEED indicator, teams have to demonstrate compliance with one (1) of three (3) options:

- Option 1. Make at least three (3) of the following building spaces open to general public: auditorium; gymnasium; cafeteria; classrooms; playing fields and stadiums; and joint parking. OR
- Option 2. Contract with specific organizations to share at least 2 building spaces. Ex: Commercial office/business; health clinic; community service center; police office; library; parking. OR

- Option 3. Use shared space owned by other organizations (min. 2 spaces): auditorium; gymnasium; cafeteria; classrooms; swimming pool, playing fields and stadiums. Provide pedestrian access from the school. In addition, provide signed joint-use agreements with the other organizations or agencies that stipulate how these spaces will be shared (USGBC, 2022g).

The proposed revision to the existing indicator integrates Placemaking strategies to strengthen LEED's current initiatives. For example, while the *Joint Use* credit requires that spaces are "[...] accessible to and available for shared use by the general public" (USGBC, 2022g), the credit revision enhances this requirement following the Inclusivity PM strategy and indicating that spaces must follow barrier-free or universal design guidelines (IP-I1).

Informed by the UNESCO, the *Joint Use of Facilities* (USGBC, 2022g) list of spaces in *Option 1* was expanded to include additional venues relevant for the local context in which the school community might socialize, "create, produce, promote and disseminate their work" (United Nations, 2014: 70). According to IP-C1 there is a lack of adequate gathering spaces in local schools:

In all the schools that I visited, both public and private, there was a total lack of spaces for students to hang out during their free time and everywhere I saw people sitting on the floor and in the hallways. It was the only place... [...] Well, we tried to provide spaces where they can sit and hangout so that they do not have to sit on the hallways; in the amphitheatre, in the plaza, on the stairs, for example, benches are created just below. In other words, in the lobby of each building there is a space where they can meet, sit and wait.

In response to this statement and aligned with the Uses and Activities PM category, additional socio-cultural spaces such as the library, exhibition spaces and open courtyards (outdoor patios) or semi-enclosed areas within them, may also be lent to the community (IP-B2; I1; K1).

Including additional spaces could also strengthen synergies between *Joint Use* and other existing and proposed credits. For example, sustainability consultants recommended that the school canteen could become a multipurpose area to host cultural activities for the community as will be proposed in the *Provide a space for*

communal meals indicator (31.4) (IP-B2, K1). Also, that the availability of communal outdoor spaces may also contribute to earn the *Open Space* credit (31.5) (IP-J1). This was done in case study schools (A-E) where ideologically the patio becomes a socialization space for the school community:

[...] certainly promoting exchange between people, the use of these patios, that is, those kinds of considerations that I mentioned are part of what I personally always try to do in the schools that I have designed ... which have been a few ... to promote that interaction between users and take advantage of the benefits of our climate, that even though the sun can be very strong sometimes we have ventilation and generally a pleasant climate (IP-A1).

Also, these cultural joint-use spaces may be used to provide afterschool cultural programs for indicator 28.4, as will be proposed in the Cultural Education category (IP-I1).

Even though the library was added as a cultural space, participants mentioned that there was resistance in the Department of Education and local schools to lend this space to the community for security reasons due to the technological equipment it houses. However, professionals recognized the importance of developing internal protocols so that schools may become a technology hub for its surrounding community, mostly during times of need such as the COVID emergency or post-disaster recovery, among others (IP-E2).

IP-I1 and J1 emphasized on the importance of **governance** for the success and continued use of joint-use spaces, from the Department of Education (DEPR) to school Directors and supporting personnel which is why training requirements were added to the revised credit:

[...] the Department has to establish it from the outset and be clear that these spaces also lend themselves to activities open to the community outside of class hours and that they have to work with the issue of security in terms of those spaces so that they can really function (IP-I1).

[...] Perhaps they have to educate management personnel so that they understand what it is that they want to do and how it should be done (IP-J1).

One (1) participant was aware that the shared community spaces provided were being used in local LEED certified schools (IP-A1), while others were unsure if these

were being utilized as planned (IP-D1, J1, K-1). IP-J1 commented that there was resistance to lend these spaces to the public whether for liability or security concerns. Also, due to the lack of resources to provide security personnel after hours. To deal with this situation, participants emphasized that the revised LEED credit must require teams to provide independent access to community spaces while providing security for the rest of the school, as was done in school B:

[...] the most important thing that the 21st century school program said is that joint use spaces must have access even if the rest of the school is closed and there is no staff to serve people [...] one of the strategies we used was a gate that had another keying system... so that they could enter this area and not enter the school... (IP-B2)

To strengthen community participation, professionals also recommended that instead of just providing a list of shared spaces in *Option 1*, a community program should be developed to promote the continued use and maintenance of these spaces. In the revised credit, project teams are required to provide evidence of community consultation processes carried out to determine the spaces needed by the people and possible activities to be held via a survey or meeting (IP-K1,I1,J1). This recommendation follows the Sociability and Participation PM strategy to strengthen sense of belonging and improve space use.

IP-J1 emphasized on the importance of locating shared spaces close to the entrance to maximize visibility for security reasons but also as a way to strengthen the school's image and link with the surrounding community, as emphasized on FNI's design guidelines (Fielding Nair International, 2010: 30). Making community spaces hierarchical in terms of transparency, scale, and/or materiality could serve to promote school activities and increase space use. Also, participants recommended that in addition to providing the pedestrian access required in *Option 3*, alternate means of transport and/ or parking spaces should be provided to make these spaces more accessible for its users (IP-K2).

In line with the Sociability and Participation PM strategy, an *Option 4* was proposed that requires the submission of a co-management agreement between private, non-profit, municipal agencies or community organizations to share the management and

maintenance of these spaces (IP-J1, K2). This becomes a way to compensate for limited funding, guarantee continued operations and strengthen relations with the community.

Also, participants commented that this credit could also foster cultural diversity (31.1) and exchange between people with different backgrounds when activities are held (IP-A3, K1). They did not recommend creating Cultural Diversity as a standalone credit mainly because most local schools are oriented to a specific community which may share similar socio-economic characteristics (IP-K2, A3). However, IP-E2 suggested additional opportunities to promote cultural diversity, such as community participation in decision making processes which will be emphasized on indicator 31.9: *The building makes people feel a sense of place, belongingness and rootedness.*

It is important to point out that even though the *Joint Use* credit was available for LEED for Schools O+M in previous versions, it was eliminated and is currently only available for BD+C. However, research findings point to the reactivation of this credit for O+M and its revision. This credit might benefit existing schools that have the spaces available and may want to strengthen the use of these venues by the community. Also, sharing or leasing spaces to the community may make sense considering the reduction of the number of enrolled students in local schools which, in turn, increases space availability (IP-J1). During the interviews it was discussed that teams applying for the O+M credit must provide evidence of the number and type of activities, number of participants and/or curriculum integration to evidence space use, which was one of the participant concerns previously mentioned. Proposed LEED documentation requirements are specified in Appendix X.

31.13. Neighbourhood Facilities (Surrounding Density and Diverse Uses)

The neighbourhood facilities theme will focus on providing recommendations to the *Surrounding Density and Diverse Uses* indicator in the Location and Transport Category in LEED v4.1 BD+C: Schools, which is the equivalent of the *Development Density and Community Connectivity* (version 3) indicator which was earned by seven

(7) out of nine (9) certified local schools (77.8%), particularly those in urban contexts.

Also, we will reference similar LEED credits that deal with the availability of neighbouring cultural facilities as criteria for site selection, including the *Access to civic and public spaces indicator* in LEED-ND v4.0 and *Green space* in LEED Communities that requires teams to provide open and/or green spaces that facilitate social networking, civic engagement, physical activity, and outdoor activities such as a square, parks, or plazas (USGBC, 2022h, 2022i).

It is important to make the distinction that both the *Surrounding Density and Diverse Uses*, as well as the previously discussed *Joint Use of Facilities* credit aim to promote school and community relations. However, the first focuses on letting school members benefit from using neighbouring facilities, while the latter emphasizes on lending spaces within the school premises to the external community.

The *Surrounding Density and Diverse Uses* credit intent states that its purpose is:

To conserve land and protect farmland and wildlife habitat by encouraging development in areas with existing infrastructure. To support neighborhood and local economies, promote walkability, and low or no carbon transportation, and reduce vehicle distance traveled for all. To improve public health by encouraging daily physical activity (USGBC, 2022j).

The statement above places an emphasis on environmental, economic, and social aspects. However, considering that the *Diverse Uses* indicator requires teams to indicate the availability of nearby civic and community facilities, it is recommended that the intent should be revised to strengthen and make evident that the cultural sustainability dimension is targeted within the credit. Adding “access to cultural experiences” on the intent’s second sentence is recommended and would read as follows:

To support neighborhood and local economies, **access to cultural experiences**, promote walkability, and low or no carbon transportation, and reduce vehicle distance traveled for all.

The *Surrounding Density and Diverse Uses* credit allows teams to select amongst three (3) different options to demonstrate credit compliance: While Option 1, Path A mandates specific density values for the site, Path B requires teams to locate the project adjacent to a previously developed location or build on an infill lot. Option 2 focuses on the availability of diverse uses within the neighbourhood and Option 3 emphasizes on walkability (USGBC, 2022j).

During the interviews, participant recommendations focused on Option 2: Diverse Uses, because it was the only option available at the time the schools were certified. This option requires teams to locate the building's main entrance within a ½-mile (800-meter) walking distance from diverse uses indicated on a list. In addition to retail, food retail and services, the credit allows the availability of civic and community facilities such as: community or recreation centre, cultural arts facility (museum, performing arts), education facility, place of worship and public parks to demonstrate credit compliance (USGBC, 2022j). Depending on the number of uses available, teams can earn from one (1) to two (2) points.

To improve this credit's Option 2, this research referenced the Sociability and Participation PM category to promote school and community relations. Neighbourhood civic and open spaces can enrich student experience while also strengthening links with the community (IP-K1). Participants suggested that neighbourhood amenities could be used to complement existing school resources and provide activities for students during and after school hours (IP-B2, K2). These school activities should be integrated with the curriculum (IP-K2). These additional restrictions were added to the existing credit language (see Appendix X for full credit). According to IP-K2, School I, which is located next to a stadium and a public pool would benefit from having programs and agreements in place where athletic students could practice sports in these facilities (Figure 8-9). Also, from having a LEED credit that rewards these initiatives. This research also referenced the **Access and Linkages** PM strategy to require teams to demonstrate that there is pedestrian access and/or public transportation from the school to civic and cultural spaces (IP-K2).

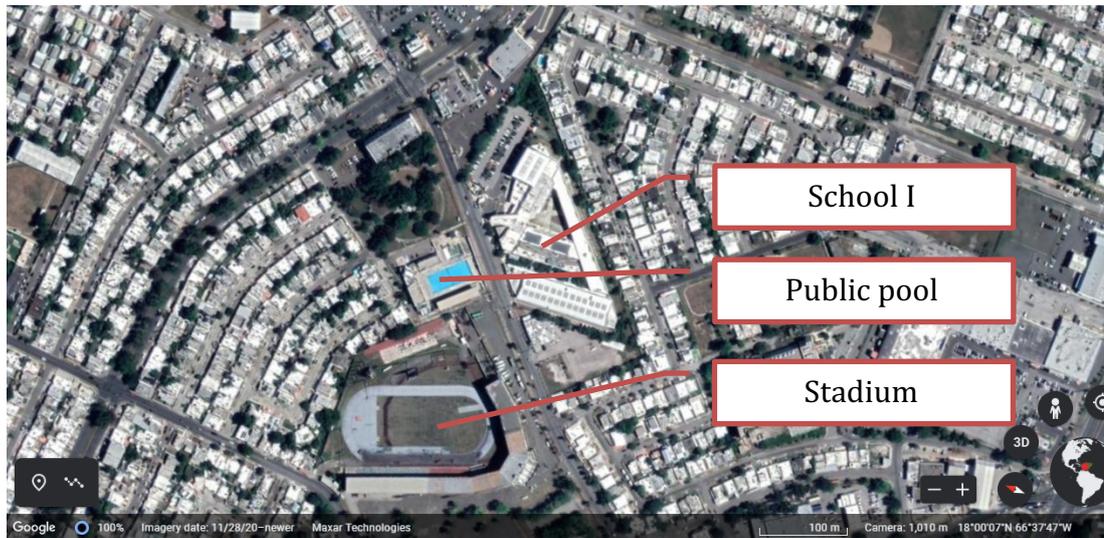


Figure 8-9: School I and neighbourhood facilities (Source: Google Earth)

In addition to current credit documentation requirements, IP-K1 suggested that project teams should provide a narrative explaining the link between neighbouring spaces and school activities, proposed curriculum, and the site plan demonstrating compliance with the required distances and facilities access from the school. The site analysis and narrative should also demonstrate that building on the selected site benefits the existing community and does not pose a risk to create stronger disadvantages to already struggling areas. Similar to the *Joint Use* credit requirements, teams will be expected to provide signed agreements with neighbourhood cultural organizations that stipulate how these spaces will be shared.

31.4. Provide a space for communal meals

Similar credits such as SBAT require a communal space where occupants can sit for meals, gather and socialize (CSIR, 2015). Furthermore, during the interviews, participants expressed additional functions that this type of space should fulfil for the local context, including the extension of the school canteen seating areas to adjacent exterior and/ or semi-covered areas, benefiting from the tropical climate (IP-I1). Being one of the Schools for the 21st Century program requirements by FNI, several schools included additional seating/ gatherings areas (IP-B2). For example,

school C included outdoor tables in the courtyard for lunch, group projects or socializing. This space, labelled as the “community plaza”, is also suitable for meetings and other events (IP-C1). Similarly, school D included a gazebo and steps where students could eat, sit, and congregate (IP-D1). This strategy is aligned with the Uses and Activities PM category, which seeks to provide spaces for socio-cultural events and, therefore, was included as one of the proposed LEED credit requirements.

Teams must submit a narrative explaining how the school canteen relates to other supporting spaces (IP-I1). Also, provide a plan marking up the communal space and a furniture layout with numbered seats and tables. Options and more guidance on how to document the seating capacity are included in Appendix X.

In line with FNI design guidelines, several participants also recommended that the school canteen could become a multifunctional space (IP-I1, J1, K1). Local school canteens included flexible and movable furniture with casters and wheels, stackable chairs, and pull-top tables. According to the FNI manual, this strategy allows for adaptability and changes to the space when required depending on the activities that will be carried out (Fielding Nair International, 2010: 65).

IP-K1 commented that since the Schools for the 21st century already have a school canteen, it should be further reinforced that these are lent and used by the community. Several participants identified a link between this credit and *Joint Use of Facilities*, because this space could be used for cultural and extracurricular activities (IP-A3, I1, K1). To achieve this, it is important that the kitchen/ preparation area can be closed-off from the dining area when necessary, and adequate furniture storage is provided (IP-K1, K2).

In addition to being a potential cultural communal space, food service in public schools plays a relevant role in the Island during emergencies and disaster recovery. On the survey, 40% (n=4/10) of participants indicated that their school was designed as a storm shelter, benefiting from rainwater collection, solar panels, strong

structure, among other advantages of green buildings. However, green schools represent a small sample of the facilities used as refuges Island wide⁵⁸. In addition to providing food to refugees, during the Hurricane Maria recovery process, open schools were used as a community centre where water, food and other supplies were provided to citizens (Ibarra, 2017).

Furthermore, when schools were closed and turned to remote learning during the COVID-19 emergency, a group of mothers and non-profit organizations demanded that the school food service was reactivated and nourishments could be distributed (Microjuris, 2020). According to Natalie Jaresko, former Executive Director of the Fiscal Oversight and Management Board for P.R., appointed by the U.S. President to oversee the recuperation from the Island's financial crisis:

There are multiple cases in which families depend solely on the breakfasts and lunches provided by school canteens [...] The Board is committed to finding a permanent solution to ensure that food assistance is provided immediately during an emergency and will ask [U.S.] Congress to make this long-term solution feasible through federal legislation [...] (Microjuris, 2020).

This validates the importance of the school food service for the community, particularly during times of need. Food distribution during this time was carried out in front of the school gate or vestibule in an improvised drive through (Periodico La Plata, 2020). The idea locating the kitchen and school canteen in a place that is more accessible by car or closer to the school entrance, as well as properly integrating a drive through was discussed with interview participants and identified as a real possibility for local schools that could be rewarded in LEED (IP-B2, J1, K2).

Schools that want to target this option, must develop a protocol for food preparation and distribution. Including, but not limited to, how the school director will identify the number of students that require the service; number of required personnel; an architectural plan that illustrates the kitchen and school canteen location, while also indicating the pedestrian and vehicular access route for food pickup (Periodico La

⁵⁸ During the 2022 hurricane season, 235 public schools were identified as potential storm shelters (Dattari, 2022).

Plata, 2020, IP-B2). LEED submittals for this option were based on requirements by the DEPR at the time and participant recommendations.

In addition to identifying a credit synergy with *Joint Use of Facilities*, IP-E2 commented that it is important to teach students about food security as part of the cultural discussion to avoid a food crisis, considering an 85% of the food consumed in the Island is imported, while only 15% is produced locally (Acevedo, 2018). IP-E2 referenced the O+M Sustainable Sites *Local Food Production* indicator as a complement to the proposed Communal Meals credit:

I would tie it to an additional criterion and that is... in O&M there is a food credit and that you provide local products in the cafeteria or that you add more vegetarian options and that the theme of the dining room is tied to the teaching of the food sustainability and what we eat and the impact of what we eat [...] that it is a green roof in an agricultural community and that they see that the girl takes the recajo out of the garden and with that they season the beans... (IP-E2)

As further research, this credit could also be revised so that in addition to the provision of a food production space, the education component on food sustainability could be strengthened (IP-E2) including, but not limited to, waste and circularity (composting, water harvesting, among others).

31.9. The building makes people feel a sense of place, belongingness and rootedness (School Community Sense of Belonging)

31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.

This credit's theme was originally derived from Wu et al. (2016: 71) Cultural Sustainability Indicators for Green Building Programs. In this journal article, the authors present the idea of 'cultural landscapes', that provide a particular character to a place. Even though buildings are important instruments that help preserve the sense of place and enhance its cultural identity, this connection may also be derived from landscape and community interactions. Wu et al. (2016: 71) includes an additional indicator titled *Cultural identity* that encourages project teams to design buildings that reflect collective memories and protect the local history and character of a place through external appearance, construction materials or interior

decoration. However, only a definition was provided for both indicators, and no specific metrics were presented in the paper. The RESET SAS also includes relevant credits that touch upon SoP, for example, the *Spatial quality and well-being* indicator requires project teams to “develop a spatial design that takes into consideration the traditional architectural typology of the region” (UIA, 2012: 29).

As evidenced in chapter 7, references to the local history and architectural typology were integrated by professionals in the design of local schools, particularly references to the patio school, as well as tropical architecture strategies and elements. Also, the integration between the user and the landscape was of outmost importance. Additionally, during the 2nd round of interviews, participants also emphasized on the importance of the provision of opportunities, projects and spaces that the school community can take ownership of and are related to the school theme; community participation in decision-making processes and school maintenance; as well as the display of elements showcasing community ownership (IP-E2, J1). These recommendations were further developed and integrated in this LEED pilot credit requirements.

The theme expressed on the survey: “the building makes people feel a sense of place, belongingness, and rootedness”, was transformed and adapted as the new credit’s intent which is to “strengthen the user’s Sense of Place and Belonging by providing opportunities, projects and spaces that promote school community ownership and participation in decision making processes.” This adaptation emphasizes that, in addition to the provision of spaces, programming and user participation are also essential to strengthen user’s sense of belonging. This is also stressed on the proposed indicator’s title: *School Community Sense of Belonging*.

This proposed credit, which will be available for both BD+C and O+M, follows the *Collaborative Sociability and Participation* PM approach, to promote participation of users, architects and community leaders in decision making processes through participatory design and community involvement strategies. To earn this credit, project teams must comply with the Community Participation requirement and an

additional Placemaking strategy. Inspired by similar SAS such as SBAT (CSIR, 2015: 64-65), the credit requires schools to have an active community/ parent/ teacher's association or equivalent to promote communication and interaction between its members. They can participate in the development and implementation of plans for school design, improvement, and maintenance, as well as the development of sustainability initiatives.

IP-E2 views this credit as an opportunity to promote Sense of Belonging but also target diversity, instead of having a standalone credit that deals with the latter, as was originally proposed in the research:

[...] I think that I would use the same strategy for Diversity and "people with a sense of belonging and sense of place" and it is [...] that the participatory methodology is used in the design process, that everyone is invited and that the invitation is open and that the methods of how to invite and who participates are also regulated [...] is to encourage that participation and then guide, facilitate the process so that it is truly participatory. Only through this method do people have a belonging, that is how people take ownership of a place when you are part of the development of that place, that is where people take pride and that is also where you can make a true connection with a diverse culture and a diversity of points of view. You have to bring that diversity to the table and for that diversity to be represented it has to be part of the discussion, that is, that process... what we know as participatory design and those methodologies of how to ensure that equity in participation, I think it answers you both credits (IP-E2).

During the interviews, it was pointed out by IP-J1 that if users feel that the school is theirs and have a sense of identity and attachment, they may be more inclined to take better care of the facilities. Similarly, Fielding Nair Guidelines state that "when the surrounding community feels true ownership with its neighbourhood school the incidences of vandalism and theft show a significant drop" (Fielding Nair International, n.d.: 8). This is also in line with several Fielding Nair strategies and others suggested by participants that aspire to strengthen the school identity and community pride. A list is included for participants to comply with at least one (1) of two (2) options. *Option 1* requires teams to create projects and spaces that the school community can take ownership of. For example, develop arts projects or gardens and invite the school community to participate actively in the development, construction and/or maintenance of these initiatives. It is important that teams demonstrate that

these activities are linked with the curriculum or school theme (IP-A3), integrated with the landscape and/or linked to the socio- economic activities and identity of the surrounding community, such as agriculture in case of School D (IP-J1) (International Living Future Institute, 2014; Wu et al., 2016: 71). For example, IP-D1 highlighted how its rural vocational school design had an impact on the academic culture, and became an aide on the teaching/ learning process. Students have allotment gardens that provide a hands-on experience on the agricultural training program. In addition to being a tool for teaching sustainability concepts, school D became a tool to teach students about one of the main economic activities and culture of the mountain region. In addition to plants, students are also taught about animal systems. One of its projects, includes gathering and selling chicken eggs, which also strengthens students’ business and entrepreneurship skills since an early age.

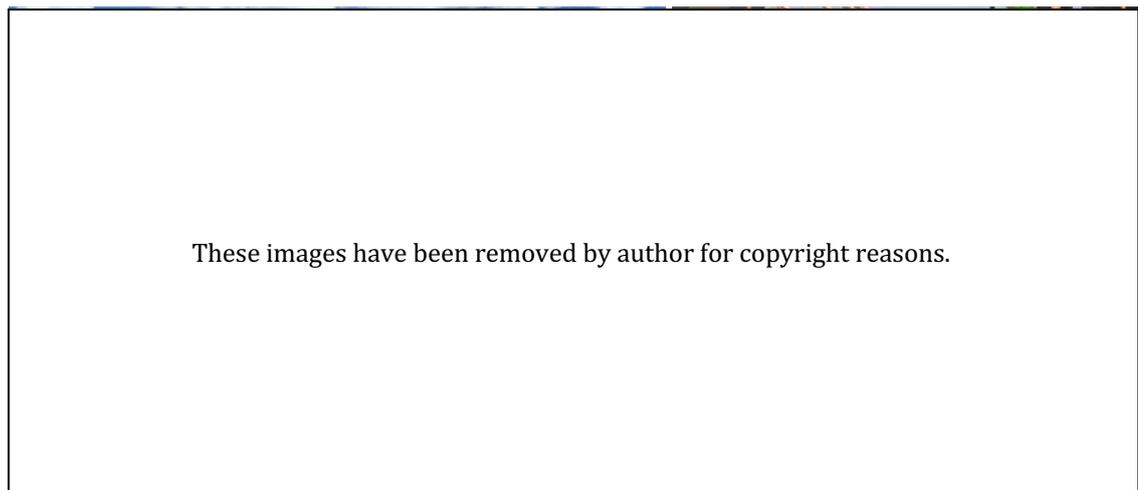


Figure 8-10: School D allotment gardens (Source: School’s Facebook page).

The proposed credit’s *Option 2* is based on Fielding Nair’s (2010: 19) strategy to create a “welcoming entry” and vestibule where school users can display elements of community ownership such as a gallery of historic photos, activities or past graduates, student work and awards, among others.

Documentation requirements referenced similar SAS such as the LBC, which includes a credit titled *Biophilic Environment* that requires teams to document how the project will be “connected to the place, climate and culture through Place-Based

Relationships” by submitting a plan that includes historical, cultural, ecological, and climatic studies that examine the project’s site and context (International Living Future Institute, 2014: 40). While participants agreed that this is a valid strategy, IP-E2 emphasized that the plan should include and evidence community/ parent/ teacher participatory processes, and its results must inform building design, operations, or maintenance. For example, community input may inform the projects that will be developed, the strategies that will be proposed and the cultural, social and environmental aspects that will be prioritized for compliance with this credit.

This credit also requires that participants submit a narrative with a list of strategies, as well as an implementation plan with applicable social, cultural, economic and environmental considerations. Teams must include a site plan or floorplan indicating where each strategy would be applied, as well as additional drawings or renderings when applicable (IP-E2, K1).

31.11. Learning environments and school culture foster creativity and innovation

In line with compatible cultural indicators by the UNESCO (2019), this indicator’s *Option 1* promotes an art- integrated curriculum with courses such as drawing, painting, sculpture, design, music, drama, literature, dance, photography, cinematography, and digital arts, among others. Participant IP-K2 also recommended including compatible courses that may also lead to student innovation such as entrepreneurship and technological education:

[...] innovation today comes from technology. I mean, you have technology labs where students can practice innovation and that kind of thing, because art and culture are important, but where innovation is really happening is in technology. So when you promote innovation and technology you are creating students who know how to innovate...

A minimum number of required hours was determined based on the median instructional time (in accumulated number of hours) allocated to aesthetic education over the first nine years of schooling in the Latin America & the Caribbean region which is 612 or at least 68 hours of instruction annually (Amadio et al., 2006: 29).

This credit (*Learning environments and school culture foster creativity and innovation*) is further validated by a collaborative agreement between the DEPR and the non-profit organization Puerto Rican Alliance for the Arts that seeks to expand and strengthen art educational offerings within the general school curriculum, and add additional offerings including architecture, literature, crafts, and film. Similarly, it will work on the creation of training projects for teachers to use the fine arts as a tool for curricular integration (El Nuevo Día, 2022).

IP-E2 also emphasized that a curriculum that fosters innovation needs to be accompanied by adequate facilities that allow students to create:

... how children can influence their own space, that they can move chairs, that the furniture is flexible, that they can change lighting levels, all of those things promote creativity and influence child development, so I definitely think it's a credit that we need to incorporate...

Consequently, *Option 2* focuses on the design of learning spaces that promote multiple modalities or dynamics of education different from the banking model that views the teacher as the depositor of information and students as the depositories (IP-A1). While the traditional school prototype in P.R. with single-loaded corridors flanking a long row of classrooms, presented little variety in the learning spaces, participants from the FNI community meetings hoped the Schools for the 21st century would provide educational environments designed to support different modalities including: Project-based Learning, Technology-based Learning and Interdisciplinary Learning (Fielding Nair International, 2010: 18). Recognizing that traditional student desk arrangements predominated in local schools, FNI design standards for 21st century schools promoted flexible interior layouts, movable wall partitions between classrooms and mobile furniture (Fielding Nair International, 2010: 36). IP-K1 pointed to these recommendations as valid and applicable for this credit:

[...] classrooms with sliding walls were provided to support the interaction between different subjects and different academic levels, similar to the Montessori method... classrooms with compatible subjects were chosen and Da Vinci classrooms were also created which was a science, art and technology lab. Which, well, the idea was that it should be a holistic teaching, that you are not only focusing on science but you are doing science with concepts of art and you have technology integration [...]

Furthermore, pointed to the schools for the 21st century program DaVinci classrooms that facilitate interdisciplinary learning (Fielding Nair International, 2010: 22).

According to Abd El Gawad et al. (2019: 970) “when a space is comfortable, it can represent itself well and leave a good image in people’s minds”. Consequently, those teams that want to target the Comfort of places to sit PM strategy must specify functional and ergonomic furniture for administrative staff, faculty, and students. Children’s furniture must be age-appropriate and selected according to the specific needs of the different programmatic areas. Also, furniture arrangements and layouts, particularly in learning spaces should be flexible enough to encourage students to work collaboratively and improve the interaction with teachers (Fielding Nair International, n.d.: 5). While active furniture, such Hokki stools that allow the child to be seated but moving, were specified in 21st century schools following FNI guidelines (Figure 8-11), IP-K1 indicated that the DEPR did not give adequate training to the teachers in the use and handling of this type of furniture in the classroom. While the School A library features Hokki stools as alternative seating for students, in other cases, stools were unused and stored indefinitely inside a closet. For this reason, this cultural indicator requires that adequate training is provided to school users on how to use, maintain and customize each furniture piece.

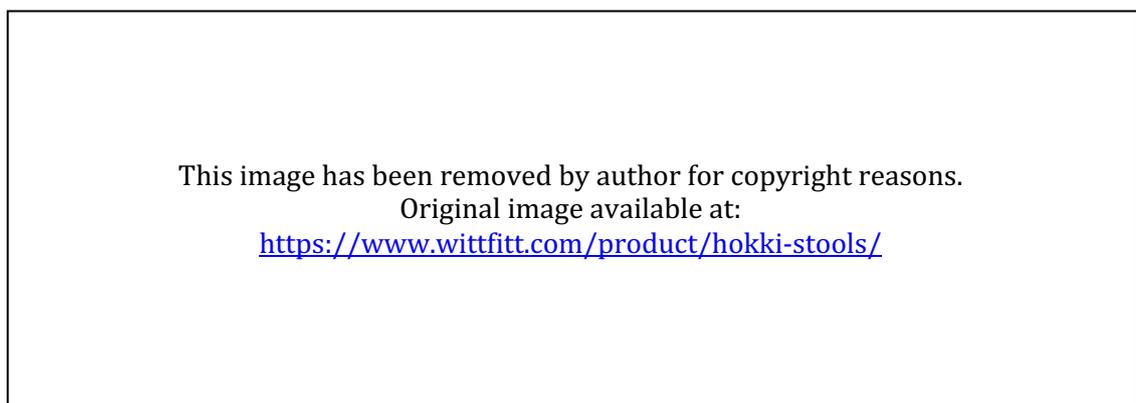


Figure 8-11: Hokki Stools. Left: Source: <https://www.wittfitt.com/product/hokki-stools/> Right: Hokki Stools in School A Library (Source: School’s Facebook page)

However, IP-A1 recognizes that some of the initiatives promoted by FNI to increase flexibility were adequate, and are already having an impact on local schools:

I think that the Department of Education has already adopted the schools 21st century furniture that are tables that you can reconfigure in different ways to change the type of education. I understand they have already discarded the use of the traditional desk, that they are not using it in the same way as before ... that is where the germ is, it is a question of how you improve it.

To further promote creativity and innovation in local schools, IP-A1 commented on the need for outdoor learning spaces, protected from the sun and rain, adequate for our local climate:

Perhaps you could add something in terms of how outdoor space use is encouraged versus indoor spaces. The inclusion of spaces that allow cultural events but beyond [...] Well, in fact, the 21st century program had what they called the "shading pavilions", which were structures with canvas, with "trellis", they were spaces for you to be outside protected from the sun but at the same time allowed you to do some kind of activity and that kind of thing was one of the first to be eliminated for budget reasons and that kind of spaces certainly allow you, for example, to give a class [...] how can these cultural interactions be encouraged? or how can people take advantage of our climate? [...] (IP-A1).

His response points to a synergy with the revised *Open Space* credit, in which we recommended activating these open spaces through programming and the provision of adequate outdoor facilities consciously designed for learning, and suitable for the local climate. Also, promoted that hallways and patios are used to exhibit student projects, such as in school E or used as learning labs such as the agricultural land plots assigned to students in school D, which promotes a sense of ownership amongst school members.

31.13. Aesthetic Quality of the Building (Interior Aesthetic Quality)

In line with participant's recommendations (IP-I1, E2), this credit will focus on interiors to differentiate it from the *Impact of the school design on the existing townscape or landscape* (29.1) indicator which will emphasize on exterior aesthetics, as will be further discussed under the Cultural Heritage category (Figure 8-12). SBTool (iiSBE, 2015) is a compatible SAS that also includes separates credits for interior and exterior aesthetics.

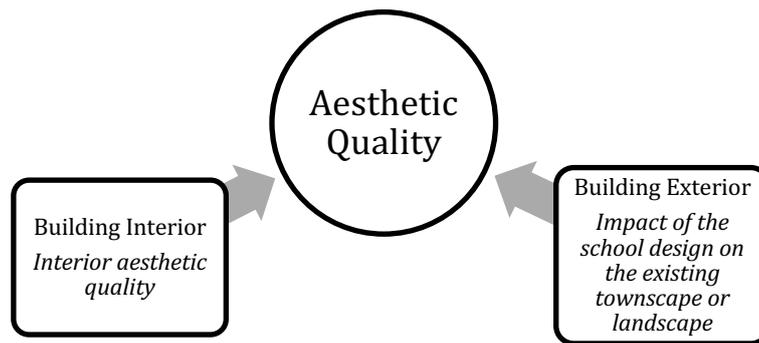


Figure 8-12: Distinction between the interior and exterior aesthetic quality. The *Interior Aesthetic Quality* indicator will focus on interior components such as material, colour, comfort, views, while the *Impact of the school design on the existing townscape or landscape* will include exterior aesthetical considerations. Diagram by author.

Impact of the school design on the existing townscape or landscape

Project teams must aim to demonstrate that the building interiors’ aesthetic value is appropriate for its cultural context and function. According to Rasmussen theories presented in Chapter 7, architectural elements and strategies such as solids and cavities; colour; scale and proportion; rhythm; texture; and daylight, among others are employed by architects to give buildings its individual character (Rasmussen, 1964: 27).

This pilot credit is proposed for both LEED BD+C and O+M. Project teams must at least comply with one (1) of the strategies under the Comfort and Image Placemaking category and one (1) of the paths under Sociability and Participation to improve sense of belonging in schools.

This credit targets the following considerations under the **Comfort & Image** PM category: interior attractiveness and quality views, as indicated by participants during the interviews, and complemented by information in other SAS and references (IGLA, 2016; iiSBE, 2015; International Living Future Institute, 2014; Wu et al., 2016). Four (4) out of seven (7) participants (57%) recognized that aesthetic considerations can be subjective (IP-A3,B2,K1,K2,) and for this reason they recommended that project teams should justify their design decisions including scale, proportions, material finishes and colour selection for their projects based on

functionality, user well-being, colour psychology, and/or cultural aspects, among others. IP-K1 made reference to the FNI Guidelines, as an example, which included a through narrative to justify colour selection in schools, emphasizing on the use of neutrals (white or grey) in combination with an accent colour inside classrooms to reduce eye strain and increase attention span in students (Fielding Nair International, 2010: 35). According to Randy Fielding, “utilizing lighter tones in combination with deeper accent colour creates a dynamic sense of place” (Fielding Nair International, 2010: 35). As presented on chapter 7, certified school interior colour palettes were selected based on intense hues associated to play (IP-E1,B1), functional colours such as yellow that repel insects (IP-E1); and the use of colour psychology for certain spaces such as the cafeteria where orange was selected for its properties as appetite stimulant (IP-I1). As evidenced, colour selection varied but was justified depending on the school context. Another alternative for project teams, under the attractiveness PM strategy is to incorporate design features and art works by the school community, local artists, among others, adequate for the space and culture, as indicated in compatible SAS such as the LBC (International Living Future Institute, 2019).

Quality views can make a place look inviting and may have an impact on the overall school image (Project for Public Spaces, 2022). The proposed credit prioritizes the connection between indoor and outdoor spaces showcasing quality views, framing landscapes, artwork pieces or collaborative spaces. Furthermore, strengthen the human/ nature connection by integrating quality views throughout the project that highlighting the natural features of the site. These views can be framed by windows, doors or serve as backdrop to gathering and socialization spaces. Also, consider effects of natural lighting entering the space, provide transition spaces or architectural elements, when necessary, to mitigate effects of extreme sunlight and glare. For example, School C is organized around a central axis that allows views through the library glass building and culminates with a natural open amphitheatre with mountains in the background.



Figure 8-13: School C. Top left: Views to the surrounding landscape through library glass. Top right: Open amphitheatre with views to the surrounding mountains. Bottom: Diagram indicates central axis in dashed line that allows views through the library glass building and culminates with an open amphitheatre (Images provided by participant, diagram by author based on floorplan provided by participant).

In addition to the strategies under the Comfort and Image Placemaking category, teams must comply with at least one (1) of the following paths under Sociability and Participation which emphasizes on the importance of community involvement to promote a sense of pride and ownership in schools, encourage school and community relations and participation in decision making processes. Therefore, this research referenced strategies in the LEED Innovation credit: *Community Outreach and Involvement* for Neighborhood Development (USGBC, 2022c) and added an emphasis

on the school's aesthetic component. Community participation is required for determining the school's aesthetic image and teams may select between two paths: administer a visual preference survey, focus group, or designate a Design Review Panel. While the LEED ND indicator defines the target population as adjacent property and business owners, residents and local planning and community development officials (USGBC, 2022c), the proposed credit adapts the requirement for schools by also including school administrative and maintenance personnel, teachers, parents, and students⁵⁹. A diverse population can bring varied points of view to the table depending on their role. Furthermore, community consultation and involvement since the initial stages of the project may foster sense of belonging and create stronger ties with the community. Local and planning officials may serve as advisors, by examining the project within the established rules and regulations, considering the overall impact of the project within the town or municipality.

Also, the indicator requires teams to establish ongoing means for communication with the community throughout the design, construction and operations and maintenance phases. Based on participant's input, a list of recommended topics was added for teams to choose from and examine on the survey and/or meeting. The list includes, but is not limited to, the following areas: material and colour selection, proportions and scale, daylighting, art integration, views and connection between the interior and exterior.

While Path 2 requires teams to convene a **Design Review by Expert Panel and/or the School Community** similar to SAS such as SB Tool (iiSBE, 2015), which includes an independent design review to evaluate the project's aesthetics proposal. Panel members may include architects, interior designers, contractors, local planning, and community development officials, among others. During the interviews it was also suggested that professors and students from local architecture and interior design schools could be involved in the review process (IP-A3). IP-A3 commented that one of the strategies employed to earn the indicator Green Signage was a collaboration

⁵⁹ It is important to verify local regulations, which may require parent's written consent to involve students in the research.

with students from the School of Architecture at the University of P.R., who graphically designed signage about the building's sustainable features. Involving local professionals or students that understand the microclimate may contribute to make innovation credits more context specific.

Determining the proposed LEED submittals required to document the aesthetic quality of the project for BD+C and O+M was rather challenging and interesting considering the subjectivity of the topic. In the end, participant responses were rather practical considering they referenced documentation similar to that required in other LEED indicators, that allowed teams to express and justify the reasoning behind their design and aesthetic decisions. To further define this qualitative aspect, participants recommended using the narrative format to discuss aesthetic issues or opportunities of the project, accompanied by architectural plans and renderings, as well as material specifications, when applicable (IP-B2, C2, K2). However, when applying under LEED O+M, in addition to the previously mentioned requirements, teams must provide an improvement plan that incorporates the cultural, aesthetic, design and art elements that will be included on the project (IP-I1).

8.4.2. Cultural Heritage

Cultural heritage includes the “legacy which we receive from the past, which we live in the present and which we will pass on to future generations” (UNESCO, 2020). Spaces may also house intangible expressions including performances, arts, rituals, festive events, and crafts, among others, that have the potential to promote a sense of individual and collective sense of belonging (UNESCO, 2020). While local school building spaces oftentimes house events that highlight local culture and practices, outdoor spaces may promote multisensory experiences such as those described by Pallasmaa (2012) (Chapter 5) and lead users to seek comfort under shaded spaces that lead to *vivencias* or everyday experiences as described by Stagno (2001: 177, 183) (Chapter 7).

Indicators that were selected as most important for the local context by participants on the survey and shown in Table 8-2 consider the impact of the proposed building on the existing context while aiming to protect the character of place and local history. Also, encourage the adaptive reuse of school buildings and raising awareness of its heritage value amongst the community and public.

Cultural Heritage Category- Proposed Indicators	New Credit	Existing Credit
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable (Building Life-Cycle Impact Reduction)		X
29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities (School as a Teaching Tool)		X
29.1. Impact of the school design on existing streetscapes. (Impact of the school design on the existing townscape or landscape)	X	

Table 8-2: Cultural Heritage category proposed indicators. The table above lists the existing credits that will be discussed on this section.

29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable (**Building Life-Cycle Impact Reduction**)

The analysis of cultural heritage credits in other SAS revealed that some only focused on historic buildings (Green Building Council Australia, 2015; United Nations, 2014; Wu et al., 2016), while others presented a more encompassing view of the building stock (iiSBE, 2009). Initially, the interview script discussed with participants focused on developing recommendations for the LEED for ND Green Infrastructure & Buildings (V4) indicator titled *Historic resource preservation and adaptive reuse*. This credit was selected by the main researcher because it dealt with the reuse of abandoned school buildings. However, during the interviews participants recommended selecting the LEED BD+C: Schools credit *Building Life-Cycle Impact Reduction* in the Materials and Resources category (BD+C Schools, v.4.1), whose intent is “to encourage adaptive reuse and optimize the environmental performance of products and materials” (USGBC, 2022k). They recommended broadening up the spectrum and, in addition to historic structures, also include existing schools that have not been identified as historical properties:

[...] people must be aware of what building heritage is... not just because it's old. Look, at the value of this building at this time because it created this landscape and it created these qualities for the environment... that's also important (IP-K2).

[...] a building has value either because sometimes it is simply the oldest school in town, or [...] a value for its innovation... when the ecological school was built, it was a pioneer project for Puerto Rico (IP-J1).

According to IP-D2, this way, the credit would encompass more of the Puerto Rican context where, perhaps, the portfolio of registered historic properties⁶⁰ is not as broad but there is a significant number of abandoned school properties and others currently in use that need renovation (Vélez, 2021). By promoting the use or reuse of these structures, adapting them to current educational trends and structural requirements would save a lot of material and energy, which in the end is what a sustainable building is, or an eco-friendly development should be (IP-I1). This may also reduce construction costs, so that one does not have to be demolish and rebuild when you can preserve and reuse some of the building's structural components (IP-I1). It is important to point out that School F was the only local LEED certified school that earned the version-3 credit equivalent titled *Building reuse: walls, floors and roofs* for conserving elements of the existing structure as part of the proposed school renovation. The remaining schools that were certified were either new construction or major renovations. However, further research could analyse if other existing schools that were renovated or “modernized” under the Schools for the 21st Century project might have qualified for this credit if they would have been LEED certified.

The *Building Life-Cycle Impact Reduction* credit requires project teams to demonstrate reduced environmental effects during initial project phases by reusing existing building elements or demonstrating a reduction in materials use by complying with one (1) of two (2) options (USGBC, 2022k). Option 1: *Building and*

⁶⁰ Historic properties in P.R. must be registered under the National Register of Historic Properties. The State Office of Historic Preservation (SHPO) is responsible for maintaining an inventory and nominating properties to the National Register (Dattari, 2022). As of November 2020, there are 355 properties included under the National Registry, out of which 31 are schools (8.73%) (SHPO, 2022).

Materials Reuse rewards teams for the percentage of existing structural and/ or non-structural elements maintained based on the project area, ranging from 15%- 75%. Additionally, IP-K1 recommended that a narrative and/or cost-effectiveness analysis must be included to confirm that economic, social, cultural and environmental resources are being saved by reusing portions of the building rather than demolishing it. Furthermore, Option 2 requires teams to conduct a cradle-to-grave life-cycle assessment of the building's structure and envelope to demonstrate a percentage reduction for global warming potential and additional impact categories as compared with a baseline building (USGBC, 2022k).

While the credit focuses on reusing existing building components, it would also benefit from design strategies that facilitate future changes to the building when needed. For example, IP-J1 commented on the relevance of the design of adaptable buildings for the local context:

Today we are seeing that the number of students has reduced. We have very large schools that are not being used to its maximum capacity, but you still have to incur in operations and maintenance expenses [...] So I would definitely promote that spaces are designed in a flexible way so that... based on the circumstances that we are experiencing and that we have seen in the past years... that people are having fewer children... Well, how can we create collaborations so that the operations and maintenance phase is not a such a burden and that in the end they have to close the school because unfortunately they did not have enough enrolled students [...] Sometimes, depending on its location, it could even function as a mixed-use building.

If buildings are designed with adaptability, this might help to further modify unused spaces and/ or rent them to community organizations or other compatible uses. Similarly, IP-A3 believes that new construction buildings could benefit from a credit that rewards adaptability, facilitating the future reuse of building elements.

The transformation of a building for a new purpose, includes the reuse of existing structures and materials, transformative interventions, as well as the continuation of cultural phenomena (Wong, 2017: 30). Furthermore, these initiatives may support the preservation of individual and collective memory through tangible heritage (buildings). The reuse, adaptability and renovation of unused buildings may benefit

existing communities and support their cultural, social and economic growth. Figure 8-14 shows local examples of previously abandoned schools transformed by non-profit organizations into cultural centres, including La Goyco Community Workshop in Santurce and the former Labra school (Chapter 4), currently the Contemporary Art Museum.

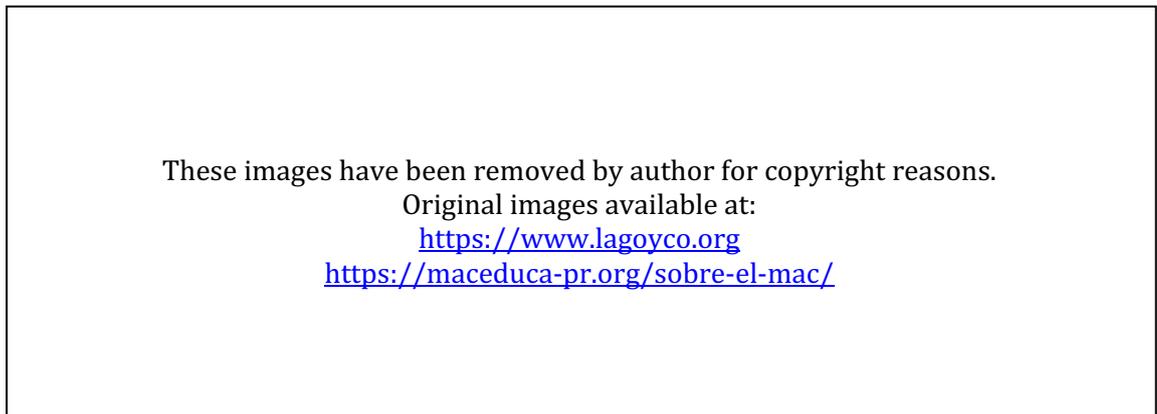


Figure 8-14: Adaptive reuse of school buildings. Left: Community Workshop La Goyco (“Taller Comunidad La Goyco,” 2020). Right: Former Labra School converted into the Contemporary Art Museum of Puerto Rico (Museo de Arte Contemporáneo de Puerto Rico, 2021). Both buildings located in Santurce in the municipality of San Juan, P.R.

Considering the adaptability concept was included in the Fielding Nair guidelines for the Schools for the 21st Century Project and strategies were implemented in several schools (Fielding Nair International, 2010b: 66), it was also included in the proposed Design PM category. For example, School A, incorporated a modular design using a prefabricated construction to allow certain changes over the years. By completely freeing the interior façade from the columns, it is easier to modify it, if needed. Similarly, aluminium sliding doors were installed in adjoining classrooms to combine rooms into larger spaces (IP-A1). Likewise, School E buildings or pavilions had few interior partitions to create a flexible layout (QP-E1).

Literature review analysis of Saleh and Chini’s (2009: 33) proposal for a new LEED credit titled *Design for Adaptive Reuse*, revealed the possibility of adding a third option to LEED’s existing credit to encourage design for adaptability and promote increased building longevity. According to the authors: “Buildings designed for adaptability ideally have a much better use of space and materials during their life

cycle. Designing for adaptability increases the flexibility of spaces allowing the occupants to use the floor areas more effectively” (Saleh and Chini, 2009: 30). A study by Russell and Moffatt (2001: 4) has also pointed out that most buildings get demolished for their inability to adapt to new trends and technologies and not for structural problems.

This proposed third option titled *Design for Adaptability* would focus on designing schools for future reuse so that it is easy to readapt them for upcoming needs because the building systems are flexible. Option 3 would require project teams to demonstrate compliance with up to (5) of the following strategies based on guidelines by the American Society of Testing and Materials (ASTM, 2020a, 2020b, 2019), Saleh and Chini (2009: 33) and interview participant recommendations. Even though these are focused on offices, it is proposed that they are adapted for the school context:

- Design luminaries, air diffusers and exhaust air ducts for easy relocation or removal
- Design data and electrical systems with spare capacity and easy access
- Design for easy relocation or removal of partition walls
- Select a structural system that allows spaces to be easily reconfigured
- Provide access pathways for changes to building utilities and infrastructure
- Adopt “open-space” concepts where possible and design multiuse spaces that can be easily adapted depending on the program or activity (IP-K1)
- Specify movable room dividers for classrooms, that can be opened or closed when needed (IP-A3)

Documentation requirements provided by Saleh and Chini (2009: 33) that are of relevance to this credit’s proposed Option 3 include the submission of a list of strategies that will be employed to promote the building’s adaptability. Also, teams must provide the plans and detailed specifications of relevant building components and materials that demonstrate their expected service life.

29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities (The school as a teaching tool)

Considering this credit’s theme focuses on raising awareness of the building’s heritage value by implementing educational activities and initiatives, participants

were asked whether this indicator should be developed as a standalone credit or merged with the existing indicator *School as a Teaching Tool*, which has a similar goal of educating users about the building's sustainable initiatives. The majority of participants (n=5/7, 71.4%) indicated that cultural requirements could be included as part of this LEED existing credit.

The *School as a Teaching Tool* indicator was selected considering six (6) out of nine (9) case study schools in the Island (66.7%) earned this Innovation credit. While this credit initially focused on linking sustainability concepts and initiatives with the curriculum, later revisions added training requirements for teachers and students, as indicated in the full credit version in Appendix X. Both teacher and student training require users to undertake self-paced online training programs or courses by the USGBC (Option 1). As further research, these could be revised to strengthen its socio-cultural component. However, Option 2 gives the alternative of developing a customized training plan for building users, which is a more feasible alternative, considering the training can be customized by local professionals in a shorter timeframe to add topics related to cultural sustainability. Furthermore, the LEED version 3 equivalent of option 2 was used at the time to certify local schools and required teams and school administrators to design and implement a curriculum to showcase the building's sustainability features, while exploring the relationship between human ecology, natural ecology and the building (USGBC, 2009c). Recommendations to strengthen the cultural component referenced the LEED IC component *Enhance Social equity, environmental justice, community, and quality of life* IC explained in Chapter 3, which includes a brief reference to "how buildings impact culture" and the "cultural expression of values and beliefs through building design". Both topics were added as part of the themes required for teacher/ student training in the revised Documentation Requirements in Appendix X.

Throughout this research it has become evident that green initiatives oftentimes were developed or approached by local designers from a cultural standpoint, which is another reason for including a cultural component in the *School as a Teaching Tool* credit. For example, the interior courtyards used as a strategy to promote natural

ventilation, also promote socialization while responding to the Island's architectural legacy. Endemic vegetation used to reduce irrigation water, such as the hibiscus flower, are also traditionally used in Puerto Rico as cultural symbols. During the interviews, architects alluded to details of the façade inspired by architectural school precedents or allusive to the modelling clay they used as a child (IP-B1). Therefore, the building, in addition to being a tool to communicate sustainability concepts, could also be employed to teach about the local culture:

In [School E], the way I think this credit could have been relevant or would apply is that the architecture is very tropical and I think that is part of our cultural baggage and how architecture responds to our culture that is modified and molded by the climate, environment and all those things... and although the aesthetic is modern [...] you feel in a very tropical space although it has nothing to do with palms and all these tropical icons[...] but you feel in a very tropical space, with a lot of breeze, the shade, the orientation of the building [...] that tropical feeling without looking tropical at all [...] [School E] serves as an example of what I believe to be cultural heritage. (IP-E2)

Participants were not aware if the curriculum and activities developed during the school certification process are still being implemented today. In search of an alternative to training requirements, this research referenced other compatible indicators, in particular, the LEED *Green Building Education Innovation* credit. While it focuses mainly on teaching the general public about green buildings, the *School as a Teaching Tool* focuses on teacher/ student training. Considering that similar strategies could be used to educate both the school's internal and external community, a third option was added to the *School as a Teaching Tool* inspired on this credit. Furthermore, *Green Building Education* requires strategies such as including educational signs, manuals, and guided tours, which were also employed by local teams to showcase sustainable features and, in the near future, could also be applied to showcase cultural efforts. This third alternative is also aligned with the Sociability and Participation Placemaking strategy which aims to promote school and community relations.

This option could be employed as an alternative when it is not possible or feasible to comply with LEED's teacher and student training in the long run. Considering limited personnel and rapid turnover of employees in local schools, the development of self-

paced learning material becomes a viable and more permanent option, that could substitute or complement training requirements. IP-A3 expressed that signage would have been a useful alternative to showcase the building's sustainability initiatives:

In our case, we did the School as a Teaching Tool to teach students about sustainability. One of the things that we did was that all the water from the roofs was collected for gray water and the tubes were painted blue so that the children would recognize that the water came down there [...] and the idea was that the teachers were going to develop activities for students [...]

Something that I would change from what was originally done is add more signage because it was something that we tried to take advantage of... because with LEED we tried to do more with less... there wasn't a lot of money [...] but how do you teach the students? you would have to be giving training to the teachers every year [...] no, look, you can do it with signage, make it part of the graphic design [...] and I think it would be much stronger and much more usable by teachers, right now I don't think they are taking advantage of it (IP-B2).

In summary, merging features from both the *School as a Teaching Tool* and *Green Building Education* into a single credit targeted for schools will serve to communicate cultural and sustainability efforts performed by designers, both by providing training and/or visual elements that educate the school community on these topics.

29.1. Impact of the school design on existing streetscapes (Impact of the school design on the existing townscape or landscape)

The proposed theme on the survey was inspired by the SB Tool SAS indicator titled: *Impact of the school design on existing streetscapes* (iiSBE, 2009). Even though “streetscape” is typically used to describe the natural and built fabric of the street, as well as its design quality and visual effect, it mostly emphasizes on the use of elements such as sidewalks, furniture, lighting, planters, among others (Institute for Public Administration and Delaware Department of Transportation., n.d.). However, we propose substituting this concept with “townscape” and adding the word “landscape” in the credit's title, so that the impact of the proposed building is also evaluated against existing structures and the natural environment, in addition to streetscape elements. Similar SAS such as SPeAR measure the building's impact to both the townscape and landscape in its indicator titled *Form and Space* (Arup,

2012). For this reason, the proposed BD+C credit aims to promote the preservation or improvement of the existing landscape or townscape by ensuring that the proposed building's street presence is appropriate for the local context.

To fulfil this aim, the credit structure follows similar LEED credits that provide a variety of strategies for teams to choose from depending on their project's site and concept (IP-E2). This research thematic analysis of other SAS (RESET, IGL, SPeAR) and participant's responses revealed additional topics that could enrich this credit such as the development of welcoming, accessible and secure green buildings that consider the context, scale, and school identity, as will be further discussed (Arup, 2012; IGLAVI, n.d.; UIA, 2012). Project teams must comply with at least one (1) path under each of the three (3) applicable Placemaking categories to improve sense of belonging in schools, namely Access and linkages, Comfort and image and Sociability and participation.

The concept of *street presence* or visibility from a distance, under the Access and linkages category, was of outmost importance in the survey administered given that 76.9% of professionals employed this strategy in their school designs. A building's architectural presence may be defined as the degree of visibility which is appropriate or desired for a specific context and design (Dept. of Planning and Development, 2013). A site or building may hold a "high-profile" design with an individual identity, or may hold a simpler design that contributes to the block as a whole (Dept. of Planning and Development, 2013). During the interviews with Sustainability consultants, IP-E2 also commented on the importance of green school's street presence for a community:

[...] it is important because it is an example of how to do things differently [...] how architecture can be different. I think that presence is important. That is definitely not considered by LEED at all, because it is a matter of aesthetics, right... because it is part of education, it is like people knowing that "that school is so impressive" or "that school is memorable" [...]; "ah, because it is green" ...

In the previous chapter 7, we discussed several strategies underlined in the FNI Masterplan for the Schools for the 21st century project (2010) and employed in local

case study schools that may contribute to street presence. These recommendations were included in the proposed LEED credit. For instance, including a **“welcoming” and clearly marked entrance** that serves as a transition space between interior and exterior areas is of outmost importance for tropical climates. In particular, School E designers combined architectural mechanism elements, including material, colour and scale in the design of a grand entry vestibule that allow views to the inside so that visitors felt invited to enter the building (Figure 8-15). According to IP-E2:

The building entrance was designed to invite, that is, he [the architect] was very aware of the building’s first impression to the visitors [...] and you notice that it is a monumental entrance and this is an elementary school for small children but they consciously made a large entrance, completely transparent and they made an almost open entrance and you arrive directly to a central courtyard with vegetation... the school presence was very important for the architect, and I think it is relevant because, again, using architecture to convey a message [...] That they enter and feel that they [...] are invited, that they can go through. You arrive at school, and you feel that they can enter up to the center of the school... you are not limited at all, that is, entering that school is really an experience... (IP-E2).



Figure 8-15: School E’s entry vestibule (Source: Images provided by participant)

Welcoming spaces invite user interaction and reduce crime levels while enhancing pride and respect for the community’s infrastructure (Arup, 2012). Similar credits in SPeAR reward teams that “create buildings, places and spaces that look good and work well for the community” (Arup, 2012). In addition to the aesthetic component, also considers the functionality of the design. For example, local schools also included a drop off or area protected from the sun and rain for parents to drop off and pick up their children (Fielding Nair International, 2010b: 58). In addition to its functionality,

it contributes to the school's street presence and visibility from a distance. This may be done at different scales, for example, in school I the drop off was quite monumental because it had a double-height ceiling space with inclined columns. However, even though school H scale was smaller because it was in located on a smaller town and a compact site, they made their presence felt at the drop off with signage, flags and a canopy (IP-I1).

Following FNI guidelines, other schools provided a signature or identity element associated with the school's theme (technology, science, music, art) (Fielding Nair International, 2010b: 58). IP-K1 explained that some of the projects were commissioned by the architects, while others were developed by the school community itself:

We were promoting the issue of school identity as part of the schools for the 21st century and it was done as a community project or some art projects... many murals were made and many mosaics... that had to do with the area where the school was located, that is, the municipality or... the area of focus of that school whether art, or science... in some instances the architects made some design in the façade...there were many projects done by students in the school...obviously that depended on how organized they were... school [F] architects commissioned a mural from a local artist...which gave the school an identity (IP-K1).

Furthermore, the impact of the school on existing traffic patterns is also considered under the *Access to quality transit* PM strategy and the proposed credit. IP-K2 mentioned several examples of schools that are built in residential, rural or town contexts with limited or narrow streets causing unnecessary traffic congestion during peak times. For this reason, the proposed credit requires teams to analyse local traffic in the area and incorporate strategies to improve or avoid affecting current traffic patterns such as developing a marginal access street, demonstrating the availability of alternative transportation and parking and/ or building setbacks from the sidewalk to improve the pedestrian and vehicular experience (Auckland Council, 2022c, IP-K2).

In addition to the Access and Linkages considerations, we had previously explained that this credit would encompass the exterior aesthetic quality of the building as aligned with the Comfort and Image PM category (PPS, 2005). Literature review

revealed that the building scale and proportions, identified as architectural mechanism (Parsaee et al., 2015) in the previous chapter 7, are also an important tool that contributes to street presence and overall building attractiveness. Tropical SAS such as RESET (UIA, 2012) require that new projects respect the scale of the urban, rural, or natural surroundings. However, when analysing local schools, some become a landmark in the existing school street while others blend- in better with the context. For example, IP-B2 indicated that they would have used this credit to certify their school and would have prepared a narrative to explain why the school became a landmark on the residential context. First, the school is quite massive due to the prefabricated concrete material used to build it. Second, in terms of security, they tried to make the elementary school as safe as possible, considering it is close to several public housing developments. In this case, the buildings work like a wall towards the outside, everything is closed, except for the entrances and inside is the courtyard for the children to enjoy. She commented: “Explaining it that way, in some way, it does adapt to the place, serving a need for security more than the urban scale” (IP-B2). In contrast, school H, blends-in with the surrounding context and is well integrated into the community because it is composed of several single-story buildings and its location in the urban town centre allows people to walk from the town square to the school (IP-A3). Due to the variety of design responses, the credit requires project teams to justify their design decision, building’s scale, and massing. Also, inspired by similar credits such as IGL (IGLAVI, n.d.) and RESET (UIA, 2012), teams are required to retain vistas on the site and respect adjacent property vistas.

While the image of the school is important to strengthen user’s sense of place, this PM category also emphasizes on user’s comfort and the **“feeling” of safety and security**. In addition to providing physical security, it is important that users feel they are protected (IP-C1). Two (2) participants stated the importance of providing security in public local schools, which are sometimes predisposed by their location (IP-B2, J1). On chapter 7, it was pointed out that ensuring a safe and secure environment is a growing challenge for schools island wide, considering theft, vandalism, robberies, and assaults. To target these issues, participants recommended several strategies that could make students feel less attracted to doing

vandalism and strengthen the sense of belonging. If students feel that the school is theirs, they might feel less inclined to damage it (IP-J1). For example, designate an expression wall or other medium for students to express themselves. Also, IP-JI recommended involving students and personnel in school green cleaning practices. This strategy has successfully been implemented in other U.S. schools, and formalized as a program by non-profit organizations such as Healthy Schools Campaign (2019, 2015)⁶¹, which could be used as reference for those project teams interested in implementing this strategy in their schools.

It is of outmost importance that design strategies are adequate for the local context, so that the architecture itself provides users with the necessary security. As previously explained, School B, is an example of how the security is provided by the school perimeter buildings that provide children with the required protection while also creating a border between the interior and exterior. The perimeter wall becomes massive in some areas but permeable and transparent in others depending on the program, context, and views. The intention of this strategy is to avoid completely depending on additional security bars, cameras and other surveillance technologies that may make the school feel prisonlike, which was one of the critiques of the tradition school prototype expressed in FNI's manual (Fielding Nair International, 2010b: 26,48). Similar SAS such as SPeAR recommend the design of active public spaces with high levels of natural surveillance (Arup, 2012). This concept entails the placement of physical features in a position that maximizes the ability to see what is occurring in a given space, and optimize the potential to detect suspicious activities (City of Red Deer, 2022). This strategy is also relevant to ensure children safety in local schools, both on the perimeter and inside.

Similar to the *Aesthetic Quality* indicator and following the Sociability and Participation PM strategy to encourage community participation in decision making

⁶¹ The advocacy organization Healthy Schools partnered with the Green Seal global eco-certification nonprofit to create a program for healthy and sustainable facilities management, procurement and practices for schools nationwide (Healthy Schools Campaign, 2019).

processes, teams are required to administer a visual preference survey, focus group or designate a Design Review Panel for determining the school’s street presence.

Even though most participants view this credit as most applicable for the new construction phase (7/7= 100%), two (2) professionals commented that it could be adapted for LEED Operations and Maintenance and focus on the development of maintenance and remodelling guidelines (IP-K2, I1). While this research focused on developing the credit for BD+C considering the unanimity in responses for this particular indicator, further research could focus on its revision for O+M.

To document compliance with credit requirements, project teams are required to provide a narrative or list of proposed strategies and explain how they will implement them, while also including a budget and timeframe. Teams should include plans and renderings indicating where they would apply each strategy (IP-B2, I1). In the narrative, participants should reference relevant codes, ordinances and/or land use plans and demonstrate compliance (IP-A3).

8.4.3. Cultural Education

The proposed indicator in Table 8-3 promotes the development of afterschool offerings that include training in culture, multilingual education, arts, sports, and creative fields, among others. While only this education indicator was selected as important in the survey by professionals, its relevance has been validated by the announcement of recent federally funded initiatives in P.R., that include the development of after school programs with a cultural focus (Guillama Capella, 2021). This credit could also serve as reference for green schools that will be part of this governmental initiative.

Table 8-3: Cultural Education Category Proposed Cultural Indicators	New Credit	Existing Credit
28.4. Child involvement in afterschool arts and cultural programs	X	

Table 8-3: Cultural Education proposed indicator

28.4. Child involvement in afterschool arts and cultural programs

During the research interviews, IP-B4 commented on the importance of afterschool programs to promote community integration:

I believe that this should be done in all schools... the schools should be more involved with the community so that the community values and takes care of the school [...] that's why after school and cultural programs are good.

Participant interview responses align with the Sociability and Participation, Design and Uses and Activities PM categories. The above quote is evidence of how this indicator could promote Sociability and Participation, particularly a sense of ownership in school users. Similarly, IP-J1 commented that afterschool programs could also promote sense of belonging in older students by involving them as teaching assistants or tutors for smaller children:

[...] high school and middle school students who are older could become tutors. Because I believe that belonging... that if you feel important and valued then that socio-cultural relationship is generated, right? [...] It's a way of maybe not telling the high school student "stay here to take a class", but "you will feel useful". And maybe there he discovers that he wants to be a teacher or... maybe volleyball classes or whatever they are talented in... music... that they can feel... that they can also contribute (IP-J1).

The proposed indicator aims to strengthen the school and community relations, by including both the internal and external school community in afterschool programs, as was envisioned in the Schools for the 21st Century project:

Afterschool so that the student body and the surrounding community would take over the school and use it during extended hours, that is, the vision was that the school would welcome the nearby community to carry out developmental activities, community meetings, things like that (IP-K1).

Similar to the *Joint Use of Facilities* credit, an agreement with non-profit organizations and/ or cultural institutions could be signed to develop projects as part of the afterschool programs (USGBC, 2022g).

In addition to promoting sense of belonging and strengthening links with the community, participants recommended that afterschool programs should be **context specific**. This PM design category has been used in other credits to refer to the

building's relationship with its surroundings. However, in this case, thematic analysis revealed that it could also be employed to refer to the design of context specific academic programming. Participants recommended that afterschool offerings should relate to the academic programs in the schools, the socio-economic activities of the region and the green building itself (IP-E2,I1,J1).

For example, the agricultural vocational School D, located in an agricultural region, offers an agronomy program. Afterschool programs could be developed that teach students and the surrounding community how to cultivate crops and become agricultural entrepreneurs (IP-I1). This training may have an economic impact on the region because more people would be taught about the trade.

Similar to the revised *School as a Teaching Tool* credit, afterschool programs could be designed to teach students about the building's cultural and sustainable features:

How does the building itself promote arts and culture after-school activities? Art and culture must be part of the discussion... because it is part of generating a cultural and philosophical change to minimize the environmental impact [...] How do you make it relevant to the architecture of the building itself and not just extended class periods? (IP-E2)

This also creates a synergy between both credits in which initiatives designed to earn the *School as a Teaching Tool* credit could be expanded or modified as afterhours programs.

In line with the Uses and activities PM strategy, adequate spaces must be provided for after-hours programming. Cultural spaces provided for the *Joint Use of Facilities* credit could also be employed for afterschool experiences. These spaces are ideal if provided with separate entrances, access control, access to bathrooms and the parking lot (IP-D1).

Proposed documentation requirements were based on participant responses but also inspired by the *School as a Teaching Tool* credit, in which there must be a compromise that the afterschool programming will be implemented within 10 months of certification and the program will remain in place for as long as the

building remains LEED certified. This is to target participant comments in credits such as *Joint Use of Facilities* questioning if spaces are still being used by the community. Requirements for O+M are based in similar indicators such as Rosario Jackson et al. (2006) which requires evidence of the number of participants and afterschool programs or activities held (See full credit on Appendix X).

8.5. Additional Credits (Further Research)

After survey analysis, it was realized that there should have been an open-ended question in which participants could propose any additional cultural credits they deemed relevant for local schools. Therefore, this question was added during the second round of interviews (Phase 4). We will discuss the two (2) main themes that repeated amongst professional responses, the first emphasizing on **community participation**:

It seems to me that it has more to do with the integration of what is the community and what is our environment here. Which, perhaps, goes a little further than design and perhaps has a lot to do with the academic program and with the Department of Education itself... (IP-I1).

Based on participants comments, “community requirements” were included on each applicable credit (#29.1, 31.13, 31.5, 31.9) inspired by the LEED Reli format (USGBC, 2020a). However, another alternative for further research would be to revise the LEED ND- Innovation credit: *Community Outreach and Involvement* (USGBC, 2022c) as a standalone credit in collaboration with professionals, following the methodology designed for this research, so that it can be applied to the school context.

The second theme for the development of additional indicators relates to the inclusion of bioclimatic and passive design strategies in LEED projects:

[...] bioclimatic responses, passive architecture, needs to have more presence in LEED and be conducive to points beyond being integrated into the energy efficiency and conservation. I believe that bioclimatic architecture connects you with the landscape, with the climate and therefore with your culture as vernacular architecture did at the time. (IP-E2)

[...] that idea of regionality... that is, in terms of a tropical environment, LEED is not very friendly to a conceptualization of a building that does not have air conditioning, that is, ambient mechanical systems, so we found a hurdle during the certifications because a public school in Puerto Rico doesn't usually have air conditioning [...] We are already greener on that side and then when you are incorporating concepts of cross ventilation and all this, well, you don't see the benefit as much as you would in a public school in the United States because it [LEED] is not regionalized for the tropical environment... (IP-K1)

Even though LEED guidelines may be used in different climates zones, which is considered a plus, it falls short to incentivize passive design strategies, which have been typically used as part of the traditional architectural typology of the tropical region and have demonstrated their effectiveness in the reduction of energy consumption. As previously discussed on Q11 of the survey (Díaz, 2020), professionals indicated that common architectural elements employed in the school design that contribute to the expression of P.R. culture include climatic features (90%), as well as building configuration, among others. Furthermore, QP-E2 commented: “[...] in Puerto Rico most of the year, in a well-designed building with passive bioclimatic strategies implemented, living in naturally ventilated spaces is possible and even preferable.” During the interviews it was also discussed that it is common practice in P.R. to employ cross-ventilation strategies, in addition to ceiling fans, to enhance air flow in schools all over the Island. However, demonstrating compliance with LEED requirements in naturally ventilated buildings in tropical climates was a “daring task”, as described by QP-H1, because the “provided standards are created for other climates”.

For example, to comply with the LEED v3 prerequisite *Minimum Energy Performance*, at the time, projects had to demonstrate a 10% improvement in the proposed building performance rating for new schools compared with the baseline building rating (USGBC, 2009d). This credit referenced the building performance rating method in ANSI/ASHRAE/IES Standard 90.1-2007, Appendix G, the Energy Standard for Buildings used as reference for the development of an energy model. It is important to point out that all projects need to comply with this credit in order to earn the LEED certification.

One might think that passively cooled buildings would be most efficient since less energy is consumed. However, in modelling, most energy savings can be demonstrated in the air-conditioned sections of the building by specifying more efficient equipment as compared to the baseline. If the whole building or most of it is naturally ventilated, it would be very difficult to comply with this LEED prerequisite as the credit is based on the percentage of energy savings. It focuses on rewarding energy efficiency instead of energy conservation (IP-B4).

Another critical aspect is the building envelope. The typical operable jalousie window specified for schools was selected because it allows natural breezes to flow through, the louvers are made of glass to allow sunlight and have integrated metal bars, which support the glass panes but also provide security against vandalism and hurricanes. It was very difficult for these single-pane glass windows to comply with the Solar Heat Gain Coefficient (SHGC) value, which measures a window's ability to reduce heat gain during direct sun exposure. The glazing performance values are easily met by other window types with high efficiency glass, commonly used in enclosed spaces in temperate climates or air-conditioned buildings. Other passive strategies such as brise-soleils, deep awnings and vegetation may be included in the energy model and contribute to the reduction of cooling loads. Indirectly, they may have an effect to achieve the energy performance credits but are not explicit or part of the LEED credits.

In terms of building configuration, all case study schools have an interior patio or courtyard as a common organizing element, as discussed in survey question 11. This open space, that is part of P.R.'s architectural heritage, is beneficial for cross ventilation and the reduction of energy consumption. These open spaces become areas for socio-cultural exchange and activities amongst the school community. However, the traditional school designed for temperate climates with an enclosed double loaded corridor would be more effective for energy performance calculations in showing a percentage (%) reduction of energy model as compared to the baseline, even though it is not typical or the most adequate design solution for our climate. The environmental benefits of this spatial configuration would not be reflected on the

energy model as natural ventilation is not represented.

Considering the importance of passive design for the local context, an additional thematic analysis was done focusing in tropical and international SAS that include standalone credits that deal with this topic (BCA, 2016b; IGLAVI, n.d.; iiSBE, 2015; The Energy and Resources Institute et al., 2014; UIA, 2012). During the interviews, participants were asked to rank the themes identified in order of relevance, being one (1) the most important and five (5) the least, resulting in:

1. **Building orientation:** Locate the building considering sunlight, wind and shade
2. Encourage **natural ventilation** when possible.
 - Determine the comfort zone for naturally ventilated spaces
 - Include mechanisms to monitor passive consumption
3. **Performance of building envelope:**
 - Minimize heat gain and improve thermal comfort.
4. **Spatial design:**
 - Create intermediary spaces between interior and exterior to attenuate harsh weather conditions
 - Utilize design passive strategies
 - Use of design elements to mitigate sunlight and excessive heat
5. Use **vegetation** to mitigate effects of temperature and humidity

Participant comments were taken into consideration and consequently, passive design strategies were embedded into applicable cultural credit requirements and socio-cultural spaces, considering it is part of the Island's architectural legacy. For example, proposed revisions to the *Open Space* credit reward adequate building orientation, natural ventilation, and the spatial design of outdoor courtyards as leaning spaces. Further research could focus on the revision of the LEED's energy performance credits and the development of standalone passive design credits in the above-mentioned themes identified by professionals as important for the local context.

8.6. Conclusions

This chapter closes the loop of the 4-phase data analysis carried out for this research, resulting in the revision of 5 existing indicators and 6 new Pilot Credits to strengthen LEED's cultural component. The past sections explain the methodology carried out

for the second round of interviews to sustainability consultants and mechanical engineers and analysis of its findings. Active research methods that promoted the collaboration between the researcher and expert/ professionals were carried out throughout, further validating the resulting credits with their input.

It is expected that the development of these indicators contributes to regionalize or better adapt the system for the local context by visibilizing, teaching and rewarding cultural initiatives. The utilization of LEED's format and language for the proposed credits is expected to facilitate their adoption and promote change within the already established system. The *LEED Cultural Sustainability Credit Guide* in Appendix X, that serves as companion to this chapter, will facilitate the diffusion of research findings amongst the USGBC, as well as design and construction professionals.

Chapter 9: **Conclusions and Recommendations**

9.1. Introduction

This investigation has focused on answering the following research question posed in Chapter 1: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context? Five (5) research objectives (RO) have guided this study in order to analyse if LEED addresses social and cultural elements as sustainability indicators (RO1) and determine how the system can be modified to respond more effectively to the tropical context and its particular conditions (RO2). This research identified several sustainability aspects that could be included in LEED (RO3) while proposing a research methodology (RO4), implementation strategy and modifications to this SAS and its indicators (RO5). The research analysed the applicability of LEED utilizing certified schools in Puerto Rico as case study.

This chapter is organized into five (5) main sections. Section 9.2 summarizes the research process and findings for each of the above-mentioned objectives, providing evidence that these were met. While section 9.3 presents the research limitations, 9.4 presents the dissemination strategies and potential barriers to implementation, 9.5 details the contribution to knowledge and 9.6 summarizes the opportunities for further research.

9.2. Meeting the Research Objectives

LEED and its application in P.R. was studied through a **mixed methods research**, which combined qualitative and quantitative techniques. Throughout this section we will discuss each of the five (5) research objectives, as aligned with each of the four (4) main data collection phases, namely: (1) Literature Review, (2) International Comparison of SAS (3) Online Survey and Interviews to Design and Construction Professionals, and (4) a second round of interviews to Sustainability Consultants and Mechanical Engineers (Figure 1-2). This section will also summarize findings per objective. The sum of these findings enabled us to answer the research question and propose the addition, modification and/or substitution of LEED indicators, taking

into consideration P.R.'s socio-cultural context. A table summarizing the research objectives, key issues found, proposed changes and recommendations is included on Appendix Y.

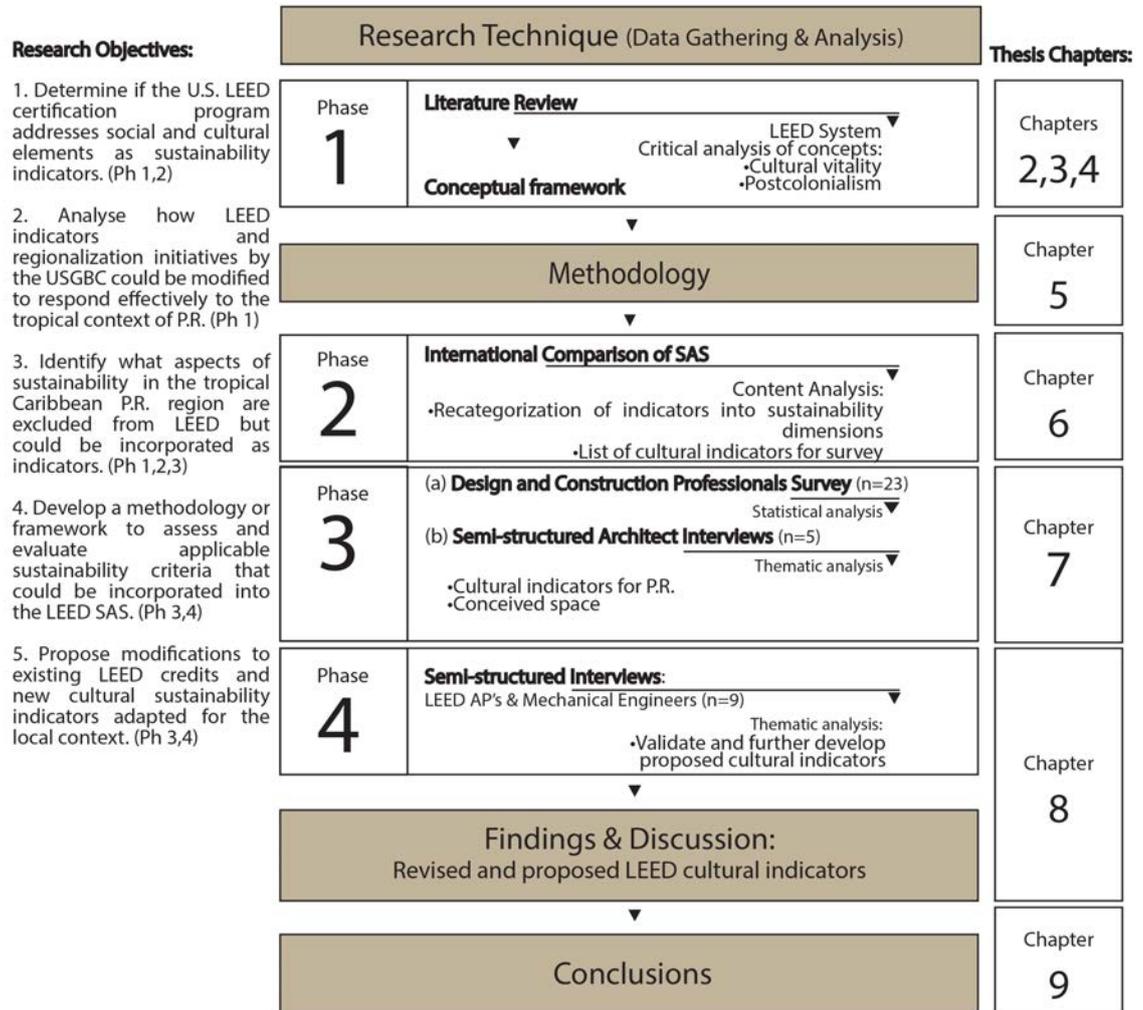


Figure 9-1: Extract from Methodological framework. Presents the alignment of thesis chapters with the research phases and objectives (by author). Figure originally presented on Chapter 1.

RO1: Determine if the U.S. LEED certification program addresses cultural elements as sustainability indicators

In order to determine if the U.S. LEED certification program addresses cultural elements as sustainability indicators (RO1), an in-depth literature review and analysis of LEED was carried out (Phase 1). The LEED v4 Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013: 2), particularly the *Enhance*

Social equity, environmental justice, community, and quality of life IC includes a brief reference to how buildings impact culture, and concepts such as cultural expression, vitality and Sense of Place (SoP). However, these terms are neither defined nor referenced on the rating system guide. Additional literature review was carried out to further define these concepts and adapt them for the context of LEED (Chapter 3).

Furthermore, the International Comparison of Indicators in school SAS presented in Chapter 6 (Phase 2), including LEED, demonstrated that the criteria focus mainly on targeting the environmental dimension of sustainability (66%), a growing trend to include social indicators (16.2%), followed by economic aspects (13%) and cultural (4.8%), as shown in Figure 6-4. This suggested the need to further develop LEED's cultural aspects, which are overlooked worldwide. Even though this research focuses on the cultural dimension, it is important to acknowledge that all sustainability dimensions are intertwined. This is also aligned with United Nation's 2030 Agenda, which recognizes culture's contribution to the attainment of Sustainable Development Goals, as explained in Chapter 1 (UNESCO, 2019).

This study also identified existing cultural indicators in LEED and other compatible SAS worldwide, in order to perform an assessment of how cultural sustainability is measured and also to generate a list of topics for local design and construction professionals to prioritize on the survey. The analysis also looked at Cultural strategies in other SAS that included but were not limited to (1) a flexible framework, (2) the use of pilot credits and (3) the inclusion of a socio-cultural category. The analysis of cultural strategies in SAS worldwide validates the approach initially presented in Chapter 3 that employs the use of Pilot Credits in the Innovation in Design Category as a tool to test the new indicators proposed as part of this investigation.

RO2: Analyse how LEED indicators and regionalization initiatives by the U.S. Green Building Council (USGBC) could be modified to respond effectively to the tropical context of P.R.

The literature review on Phase 1 also comprised the analysis of LEED regionalization strategies which include, but are not limited to, Regional Priority Credits (RPCs) and Pilot Credits (PC) (Chapter 2). Document analysis from the local USGBC chapter's RPC selection process revealed that these credits were chosen based solely on climatic and environmental conditions in P.R. (Rodriguez, 2012). Social, cultural and economic dimensions could not be considered because RPCs only recognize compliance of existing credits, and these are currently not included in LEED.

Projects may pursue PC within the **Innovation in Design Category**. This strategy allows teams to test criteria in the PC Library developed by others or submit new credits (USGBC, 2016). An analysis of existing PC in the Library gave valuable insight about trends and new criteria proposed by project teams. Within this category, project teams have proposed criteria that target societal issues such as social equity and green training for contractors, among others. As result, the USGBC's LEED Steering Committee created a Social Equity Working Group to improve the practical implementation of the proposed Social Equity PC (USGBC 2016). This suggests an interest and need for LEED to target social aspects, however, there is no mention of any cultural aspects.

The LEED innovation category could be used to test the proposed indicators product from this research, in order to adapt the system to the local context and improve its effectiveness in measuring sustainability in P.R. Once approved by the USGBC and tested as PC, a Socio-cultural Working Group, could be organized by the USGBC to further develop these indicators. The proposed PC could be used by other project teams or could be incorporated into LEED as part of a new Socio-cultural Category. Green Building Chapters could then recognize social and cultural credits as critical and select them as Regional Priorities (Figure 2-15).

RO3: Identify what aspects of sustainability in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators.

In order to identify what aspects of sustainability in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators, the literature review also included a historical overview of schools in P.R. and an in-depth analysis of Postcolonial theories to better understand the application of LEED in the Island (Chapters 3, 4). Being a U.S. Commonwealth, this American system became the standard to certify educational buildings under the Schools for the 21st Century project. Theories by Homi K. Bhabha (1994), among other theorists, were referenced to understand how initially the colonized imitates the colonizer but in the process develops a particular hybrid identity. The research investigated the cultural translation process and strategies design and construction professionals employed to comply with LEED but also to ensure that the local identity is preserved. One example would be the use of passive design strategies adequate for the local climate, even though these are not expressly rewarded in LEED.

R04: Develop a methodology or framework to assess and evaluate applicable sustainability criteria that could be incorporated into the LEED SAS.

An online survey and interviews to design and construction professionals of local LEED certified schools were the main research techniques employed to identify which sustainability considerations in the tropics are excluded from LEED but could be incorporated as indicators (Chapter 7). The survey was administered to twenty-three (23) of the thirty (30) Architects, Engineers, and Sustainability Consultants (LEED AP's) who worked in the selected eight (8) case study schools (76% completion rate) (Phase 3a). Experts were asked about cultural vitality, identity, design intention, the LEED certification process, cultural indicators, as well as a school evaluation based on placemaking concepts. As part of the survey, expert participants were asked to prioritize and select between thirty-nine (39) indicators based on the relative importance for cultural vitality in the P.R. school context. The list included indicators under the following seven (7) categories: Cultural Communication; Economy; Education; Governance, Heritage; Cultural Inclusion and Participation and Cultural Spaces. After performing a thorough quantitative analysis (Chapter 7), **a total of 13 indicators were selected, four (4) indicators already in LEED to be revised and nine (9) new indicators to be developed as Pilot Credits.**

Nine (9) indicators belong to the Cultural Spaces and Events category (69.2%), three (3) to the Cultural Heritage category (23%) and one (1) to Education (7.69%) (Figure 6-15).

Proposed indicators could promote the integration of cultural sustainability aspects into LEED to strengthen cultural vitality in schools in P.R. The **Cultural Spaces and Events category** includes indicators that promote the availability of spaces for cultural activities, social exchange, and recreation, as well as interaction with the environment. Architects emphasized on the inclusion of naturally ventilated spaces adequate for the local climate, such as open courtyards which served as a central organizing element for case study schools. These open spaces also provide opportunities for children socialization during recess time and a direct relationship with nature. This building configuration, echoes P.R. architectural tradition where the courtyard has been used since Spanish colonial architecture up to modernity.

Other socialization spaces included gazebos, wide open hallways, the adaptation of the building to the site topography, among other strategies. In all design solutions, shade from the sun and protection from rain is of utmost importance. For example, new indicators and the existing LEED credit titled Open Space could include relevant design strategies for school courtyards in tropical climates, among others, while emphasizing on its socio-cultural component.

Experts also emphasized that buildings should make people feel a SoP and belonging. In the conceptual framework (Chapter 3), we proposed to substitute the concept of SoP with Placemaking to further promote user involvement in the making of place and its own culture. During the survey and interviews, professionals commented on different Placemaking strategies employed on the school design, which informed the development of this indicator.

The **Education** category includes an indicator related to child involvement in afterschool arts and cultural programs as a strategy to promote community integration and sense of belonging.

The **Cultural Heritage** category encourages the adaptive reuse of school buildings and raising awareness of its heritage value amongst the community and the general public. Currently, schools used as a teaching tool, focus on showcasing its environmentally sustainable features. This new credit would also consider cultural elements and symbols used in case study schools for teaching and learning. Common architectural elements employed in the school design that contribute to the expression of P.R. culture, included climatic features (90%), material and colour (70%), and space organization and sequence (60%), among others. Designers employed both literal P.R. symbols such as the flag (33.3%), which is required by the DEPR, and murals, but mostly abstract references such as endemic flora in landscaping (58.3%) or architectural design features such as low relief details on the façade (Chapter 7).

After survey analysis, case study schools in the P.R.'s Department of Education (DEPR) Educational Regions I and II were selected for in-depth analysis. Semi-structured interviews were performed to five (5) out of five (5) licensed Architects who designed the selected green schools (100% completion rate). Regions with the most LEED certified "new construction" projects were prioritized. Interview questions were designed to give participant's the opportunity to delve into their survey responses. Both interview transcripts and survey responses were coded using the NVivo software, with nodes or themes relating to:

- **Design intention:** P.R. cultural identity and expression in building design and construction (architectural elements, concepts, inspiration, symbols)
- **LEED certification process:** Responses relate to user perception, dimensions targeted by LEED, professional's experience, and satisfaction with the certification process. Responses were classified into the four (4) sustainability dimensions, namely: economic, environmental, cultural and social pillars.
- **LEED selected credits:** Participant responses were aligned with each applicable credit. This allowed the researcher to develop the credit narrative and documentation requirements of new and revised LEED indicators. This

information was also used to further justify the development and inclusion of the selected indicators in LEED. Each credit also included information on applicable **Placemaking strategies** employed in the school design.

R05: Propose modifications to existing LEED credits and new cultural sustainability indicators adapted for the local context

As presented in Chapter 5, data collection methods and research instruments explored schools as cultural spaces and prioritized participant's point-of-view and interpretation, based on the Subjective Ontology and Interpretive Epistemology paradigms. Also, promoted collaboration between the researcher and professionals through Action Research strategies to propose an agenda for reform to develop indicators to improve cultural vitality in LEED.

An additional round of semi-structured interviews to seven (7) LEED AP's and two (2) mechanical engineers was carried out (Phase 4) to further develop the thirteen (13) socio-cultural indicators that were preliminarily identified as important to the P.R. context in the online survey. In this second round of interviews, there was representation from all ten (10) LEED certified public schools in P.R. Research findings from the above-mentioned techniques informed the proposal of modifications to existing LEED credits and new cultural sustainability indicators adapted for the local context. After thoughtful consideration, we determined that the most effective "political" strategy was to work for the improvement of the LEED system in P.R. as it may affect plausible change in a shorter time frame but also serve as a way of developing a methodology that could also be applicable to other SAS and regions.

As evidenced, throughout the thesis and this summary, the research process and findings informed the response to the research question: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context? Even though preliminary analysis pointed to a total of thirteen (13) indicators to be developed, the list was reduced to eleven (11) considering professional's input and analysis from the second round of interviews which led to the consolidation of similar indicators. A total of five (5) existing LEED indicators

were revised, while six (6) were new. Table 9-1 lists the names of the proposed and revised indicators.

Proposed Indicators	New Credit	Existing (revised) Credit
Cultural Spaces and Events		
31.5. Open Space		X
31.6. Joint Use of Facilities		X
31.14. Surrounding Density & Diverse Uses		X
31.4. Provide a Space for Communal Meals	X	
31.9. School Community Sense of Belonging	X	
31.11. Learning Environments and School Culture Foster Creativity and Innovation	X	
31.13. Interior Aesthetic Quality	X	
Cultural Heritage		
29.3. Building Life-Cycle Impact Reduction		X
29.4. School as a Teaching Tool		X
29.1. Impact of the School Design on the Existing Townscape or Landscape	X	
Cultural Education		
28.4. Child Involvement in Afterschool Arts and Cultural Programs	X	

Table 9-1: Proposed and revised LEED credits.

Proposed credits are included in the *LEED Cultural Sustainability Credit Guide*, available in Appendix X which will serve as a valuable tool for the dissemination of this research findings. The guide employs the USGBC Pilot Credit Application format to present the documentation requirements that would need to be submitted to earn each new credit, accompanied by applicable technical information to ensure that these indicators relate to the P.R. context. The guide also includes proposed qualitative and quantitative metrics for the new and revised LEED indicators. A summary of the proposed Pilot Credits and changes to the existing indicators is included on the guide's Appendix 2. These indicators might later be used by professionals on their future projects or to re-certify existing local schools under LEED's Operations and Maintenance. Also, may be adapted for other LEED building typologies.

It is important to point out that Placemaking strategies were added to the proposed credits as part of the requirements project teams must comply with to earn each applicable indicator. This presents an innovative approach from this research that fosters user involvement in decision making processes and promotes an increased sense of belonging. This, in turn, may promote that users take better care of buildings, equipment and contribute to meet the established sustainability goals. Also, local strategies employed by professionals in case study schools, adequate for P.R.'s climatic, economic, and socio-cultural conditions were also included to promote the adaptation of indicators for the local context of P.R.

9.3. Research Limitations

Two (2) main research limitations were identified during this process, related to the target population and gender diversity. As explained in Chapter 3, the initial target population also included school directors, in addition to design and construction professionals. Unfortunate events, that included a 6.4 magnitude earthquake on January 2020, as well as the Coronavirus (COVID-19) pandemic, made it impossible to obtain the required permissions and conduct the survey within the established timeframe. However, the draft research instrument is included in the PhD thesis Appendix C as reference. In the near future, I endeavour to revise the research instrument based on this pilot study results and administer the instrument to school users. Further research may compare user perception and space use informed by directors, with the design intention and cultural expression indicated by professionals in this thesis.

When analyzing the design and construction professional's participant profile and sample gender diversity on phases 3 and 4, there was representation from both genders. However, on the survey and first round of interviews the majority were male (Chapter 7). This may be representative of the construction sector in P.R., which is male dominated. Participant selection for the second round of interviews (Chapter 8) was based on the profession and role in the project, giving priority to sustainability consultants and mechanical engineers. However, the majority of participants on this round were female (77.8%). The majority of sustainability consultants for the

schools for the 21st century project were female and engineers were male. In the future, I would try to reach more people to obtain a more diverse sample within each phase.

9.4. Dissemination strategy and potential barriers to implementation

As explained in Chapter 8, the research findings implementation strategy pointed to Pilot Credits as an effective way to propose the new credits product from this research. While the original intention of this research was to submit the proposed Pilot Credits directly to the USGBC, these may only be submitted by USGBC member organizations (USGBC, 2017). Considering that the researcher is not part of or does not work for a member organization presented a potential barrier for the implementation of the initial dissemination strategy. However, LEED's ongoing Call for Ideas presents an alternative to submit the research findings presented in this thesis for consideration of LEED Committees and Technical Advisory Groups. After the Viva and further dissemination, proposed credits and revisions to existing ones will be sent directly to the USGBC by using this method and filing out the form available on their website. As indicated in Figure 9-2, dissemination strategies include emailing the *LEED Cultural Sustainability Credit Guide* (Appendix X) to the design and construction professionals that participated in the study with a feedback form. The booklet could be revised based on comments received from these professionals. This booklet may also serve as reference for professionals that may want to submit the credit as part of their project's certification process.

After the Viva, the researcher will also make the arrangements to present the proposed LEED credits resulting from this thesis to the USGBC P.R. chapter and/or the USGBC Florida Caribbean Regional Committee. An additional focus group could be organized with design and construction professionals as a way to communicate the ideas presented on this document but also to gather their feedback. Also, actively participate in research and professional conferences such as the annual *Greenbuild Conference and Expo*, promoted by the USGBC to educate professionals on LEED and sustainable technologies. This event offers an opportunity to present the

methodology employed for this research and proposed PC's directly to LEED users. Moreover, the researcher will endeavour to publish the research findings in peer-reviewed journals.

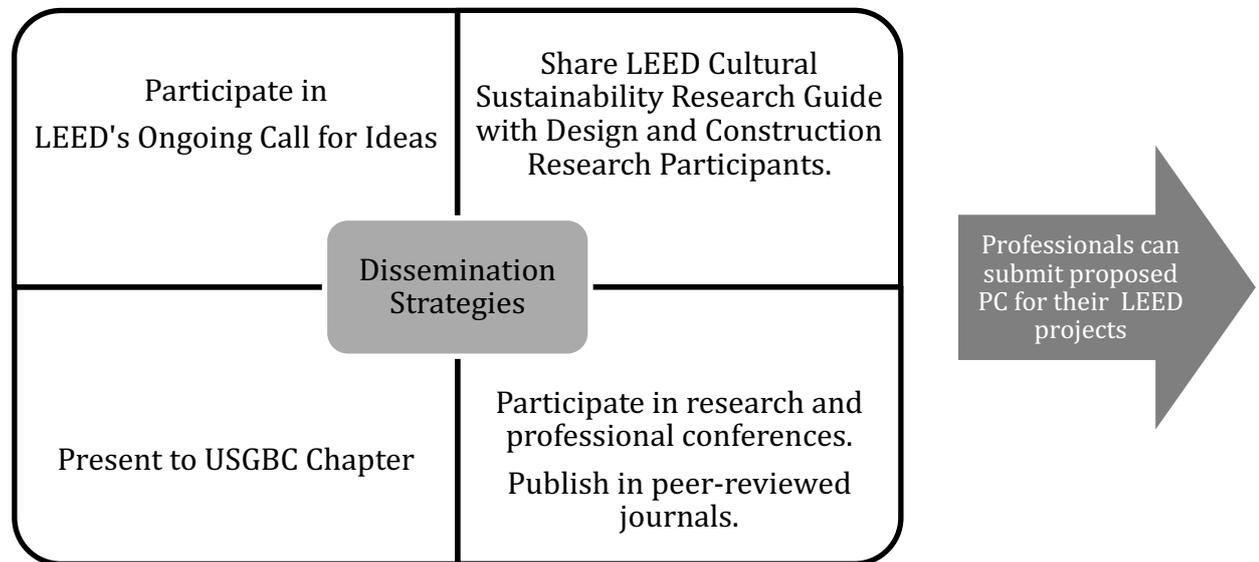


Figure 9-2: Dissemination Strategies

9.5. Contribution to Knowledge

The contribution of this research is to explore the effectiveness of the LEED certification system outside its country of origin (U.S.). The study included the development of a methodology or framework to assess and evaluate applicable sustainability criteria that could be incorporated into the system.

This research included a benchmark analysis of 1,462 indicators from SAS worldwide that revealed the need to include and/or strengthen additional sustainability dimensions beyond the environmental one, which clearly dominates in SAS worldwide (Figure 6-4). This analysis could serve as a starting point for the development of additional credits under the social, economic and cultural sustainability dimensions and could be a valuable tool to evaluate existing SAS. A Coding Manual was developed to ensure consistency in the coding process, facilitate replications and/or updates of this study when new SAS versions are launched.

This research also proposed new LEED cultural indicators that could improve this environmental assessment tool for effectively responding to the local context. This study included Action Research strategies and strong consultation processes to bridge the gap between LEED and its users. The inclusion of design and construction professionals in the Pilot Credit (PC) development processes ensures that the proposed modifications are relevant for the local context and meet user needs. It is important to point out that the professionals involved could benefit from this thesis findings and employ these PC's in their future certified projects. The *LEED Cultural Sustainability Credit Guide* (Appendix X), resulting from this thesis will facilitate the dissemination process amongst LEED users and the USGBC, while providing professionals with the necessary information to submit the PC's.

The research instruments developed (survey and interview questions) served as tool to build a cultural profile of schools in P.R. and understand design and construction professional's design intention and definition of P.R.'s identity. Also, informed which architectural and Placemaking strategies were employed in case study schools. These strategies informed the development of new and revised context specific indicators. Proposed PC also presented an innovative approach by including placemaking strategies within LEED credit requirements as a way to promote user involvement in the making of "place".

In the future, both the methodology employed, research instruments and findings could serve as reference to further analyse LEED's implementation in P.R., as well as in other countries, or evaluate other SAS for improvement, particularly those in the Caribbean. This research could also serve as a model for professionals that may want to propose new indicators adapted for their country or region.

9.6. Future Research

While it is expected that results from this research contribute to further adapting the LEED SAS to other local contexts, additional improvements to the system could be made. Different opportunities for future research were presented throughout this thesis chapters. For example, it could be further explored why there has been a

reduction in the growth of LEED certified projects in P.R., as presented in Figure 2-4. An in-depth analysis of participant responses to the interview question: “What aspects promote/hinder the adoption of LEED certification in P.R.?”, could shed light into LEED’s market positioning in the Island in order to determine which successful features could be exalted and improve those that hinder its implementation. While LEED is currently not tailored to integrate socio-cultural aspects, it is up to the designer to incorporate this into the sustainable efforts already in the system (IP-B3). However, participants view the Innovation in Design category and PC’s as an opportunity to target and further strengthen these sustainability dimensions (IP-P1), further validating the implementation strategy proposed by this research project.

One of the aspects that could be improved and was targeted by this investigation was the inclusion of additional sustainability dimensions beyond the environmental one. Following the proposed methodology for the International Comparison of SAS in Chapter 6, further research could explore the development of additional cultural, social and economic indicators and/or strengthen these dimensions on existing indicators. Also, the International Comparison study could be updated as SAS are revised, and new indicators are launched in order to compare results with this thesis findings.

The International Comparison of SAS also revealed that some SAS indicators overlap or target more than one pillar. Further research could propose more holistic indicators that target the broad sustainability spectrum, so that the initiatives carried out by the project team could benefit the environment, society, culture, and economy. Additional investigations may examine other sustainability dimensions and revisit the credits resulting from this research to add compliance with additional applicable pillars.

While chapter 6 analysed the Cultural strategies employed in SAS worldwide to include the cultural dimension, this research gave priority to the development of Pilot Credits as a short-term tool to affect change through the development of LEED cultural indicators. Further research could look into the adoption of strategies in

similar SAS such as the use of a flexible framework that includes a list of indicators for participants to choose from depending on the applicability for their projects or look into the development of a socio-cultural category within LEED. The indicators product from this research could be included in both options.

The selection of indicators by design and construction professionals could be further validated by also administering the survey and interviews to school directors and supporting personnel (school users). Results from this pilot study suggested two (2) main improvements or modifications to the existing tool that should be made in order to administer it to school users: (1) The quantitative analysis in chapter 7, included the Cronbach's Alpha test to confirm the internal consistency or reliability of the survey Likert Scale questions #27-31 where participants indicated the relative importance of thirty-nine (39) cultural indicators for the local school context. This analysis revealed that some of the indicators might be eliminated or combined (Chapter 7). Another alternative would be to only include the indicators selected by professionals as most important to lower the alpha value and further validate the survey results by comparing professionals and school user responses.

(2) Also, it is recommended to include an open-ended question in the survey that allows participants to propose additional cultural indicators. While this question was not included on the survey, it was added in the second round of interview questions and proved positive results. Participants responses pointed to further integration of the community in decision making processes from initial project planning and design stages up to building operations and maintenance. While nine (9) out of the eleven (11) proposed indicators include community participation as part of the requirements, further research could also revise the existing LEED Innovation credit *Community Outreach and Involvement* that requires a meeting with the community to inform the preliminary design process and maintain communication throughout the successive project phases, hold a design charrette OR obtain endorsements. Preliminary analysis from research findings points to additional strategies that could be implemented to enrich this credit and promote community participation such as co-design practices that include full participation of stakeholders throughout the

entire planning, design and construction process ([European Commission, 2022](#), [Szebeko, 2010](#)). Also, a list of potential cultural topics for discussion with the community could be developed.

Another of the recommendations indicated by participants was the development of indicators that deal with passive design strategies. While LEED could follow the strategy of some SAS such as the BCA Green Mark (BCA, 2012) from Singapore and RESET (UIA, 2012) from Costa Rica that have standalone credits that deal with this topic, LEED could also benefit from refocusing energy credits from energy efficiency to rewarding less energy consumption through the use of passive design strategies such as building orientation, natural ventilation, performance of the building envelope, and the provision of shading through architectural features and vegetation, among others.

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APPENDICES

APPENDIX A: LEED V4: DETAILED IMPACT CATEGORY AND COMPONENTS

LEED V4: DETAILED IMPACT CATEGORY AND COMPONENTS		
IMPACT CATEGORY & DEFINITION	KEY INDICATORS	LEED INDICATORS OR METRICS REFERENCED IN THE DOCUMENT
<p>Build a Greener Economy:</p> <ul style="list-style-type: none"> ○ green building practices and overall sustainability as a central component of continued growth and long-term profit ○ ensure that sustainability is properly recognized and valued, and the hidden costs of environmentally and socially negligible building practices are accounted for ○ financially sound and sustainability driven decision-making 	Enhance the Value Proposition of Green Building	Green building education; measurement & verification; renewable energy and lighting systems; daylighting; mixed use; open spaces;
	Strengthen the Green Building Industry and Supply Chain	[Technology, services and products]: High efficiency water technology products; low-emitting materials; green cleaning products; integrative design services; commissioning; recycled products
	Promote Innovation and Integration of Green Building Products and Services	Design services and charrettes; building performance; monitoring; commissioning; occupant feedback; zero net energy and water; passive cooling and heating; shared facilities
	Incentivize Long Term Growth and Investment Opportunities	Energy and water efficiency measures; daylighting and ventilation; proximity to services and public transit
	Support Local Economies	None
<p>Enhance Individual Human Health and Well-being:</p> <ul style="list-style-type: none"> ○ protect and improve human health through changes in how we design, construct and operate the built environment. 	Support Occupant Comfort and Well-Being	Daylighting; acoustics; access to outdoors; proximity to community services; ventilation
	Protect Human Health from Direct Exposure to Negative Health Impacts	Low VOC materials; pre-occupancy flush-outs; construction management practices; ventilation
	Protect Human Health Globally and Across the Built Environment Life Cycle	Reduction of fossil fuels; Socially and environmentally responsible building material production, manufacturing and distribution
<p>Enhance Social Equity, Environmental Justice, Community Health and Quality of Life:</p> <ul style="list-style-type: none"> ○ support the long- 	Create a Strong Sense of Place	Light pollution reduction; tree-lined streets; views, landscaping and green roofs; open spaces; civic spaces; historic preservation; connection to the

<p>range vision for the future growth and community development</p> <ul style="list-style-type: none"> ○ provide universally accessible economic opportunities, supports environmental justice and human rights, addresses issues of social equity, ○ improve quality of life ○ nurture cultural vitality ○ buildings can shape the culture, politics, values, prosperity, health, and happiness of citizens 		outdoors, walkable communities, human scale environments, cultural expression; freedom to express values/beliefs through building design
	Provide Affordable, Equitable and Resilient Communities	Affordable housing; mixed use; universal design; housing and jobs proximity; heat island reduction strategies; open and dense street grids; walkability and bikeability.
	Promote Access to Neighborhood Completeness Resources	Proximity to diverse uses; community services and public transit; compact development patterns; mixed use; walkability, bikeability, open spaces and civic spaces; parks and recreational facilities; proximity to high quality public education facilities and resources; land conservation and natural resources protection; protection of local water bodies; high performance and high quality design of public buildings.
	Promote Human Rights and Environmental Justice	reclaiming and repurposing vacant, obsolete or contaminated land and buildings, Strengthening local and regional food supply chains, sustainable cleaning, purchasing and facility management policies, safe drinking water quality, indoor air and environmental quality, support community and city involvement through the provision of civic and public spaces, designing buildings that are climate adaptable and durable.
Includes social Impact Categories and Components in LEED version 4. Table based on information in Owens et.al. (2013: 15-16).		

APPENDIX B: REGIONAL PRIORITY CREDITS

Regional Priority Credits for Puerto Rico		
System	LEED Version 3	LEED Version 4
Building Design + Construction: Schools	EA: Optimize Energy Performance	EA: Optimize Energy Performance
	SS: Site Development- Maximize Open Space	LT: High Priority Site
	SS: Development Density and Community Connectivity	LT: Surrounding Density and Diverse Uses
	SS: Storm water Design- Quality Control	SS: Site Development- Protect or Restore Habitat
	MR: Building Reuse: Maintain Existing Walls, Floors and Roof	MR: Construction and Demolition Waste Management
	WE: Innovative Wastewater Technologies	WE: Outdoor Water Use Reduction
Summary	EA (1); MR (1); SS (3); WE (1)	EA (1); MR (1); SS (1); LT (2); WE (1)
Operations and Maintenance: Schools	EA: On-site and off-site Renewable Energy	EA: Optimize Energy Performance
	MR: Solid Waste Management- Ongoing Consumables	MR: Solid Waste Management- Ongoing
	SS: Light Pollution Reduction	IEQ: Thermal Comfort
	SS: Site Development- Protect or Restore Habitat	LT: Alternative Transportation
	SS: Stormwater Quantity Control	SS: Heat Island Reduction
	WE: Additional Indoor Plumbing Fixture and Fitting Efficiency	WE: Outdoor Water Use Reduction
Summary	EA (1); MR (1); SS (3); WE (1)	EA (1); MR (1); SS (1); LT (1); WE (1); IEQ (1)
Key:	EA: Energy & Atmosphere; MR: Materials & Resources; SS: Sustainable Sites; LT: Location & Transport; WE: Water Efficiency; IEQ: Indoor Environmental Quality	
	Regional Priority Credits for Puerto Rico. Table by author. Data source: USGBC 2016.	

APPENDIX C: LEED CERTIFIED SCHOOLS: CULTURAL EVALUATION (SURVEY FOR SCHOOL DIRECTORS AND TEACHERS)

LEED Certified Schools: Cultural Evaluation

Research Project: (Re) Measuring (LEED) Sustainability: From a Global Rating System to Tropical Specificity

Dear School Principal and Teachers:

You are invited to participate in the research project titled [Re] Measuring LEED Sustainability: From a Global Rating System to Tropical Specificity, which I am developing, as part of my doctoral studies at Nottingham Trent University in the United Kingdom. The aim of this study is to identify socio-cultural factors in Puerto Rico (P.R.) that could be incorporated as indicators in the Leadership in Energy and Environmental Design (LEED) green building certification system for the particular case of schools, in order to adequately adapt this system to the tropical context of P.R. The research will be developed by myself, architect Eileen L. Díaz, under the supervision of my research committee composed of Dr. Marisela Mendoza and Dr. Ana Souto.

The research sample consists of the school principals and a 30% of teachers in each of the eight (8) LEED certified schools that were part of the Schools for the 21st Century Program in the Island. The participation of the respondents will consist of answering a questionnaire that contains eight (8) sections, which include a series of questions about education, cultural identity, vitality, the LEED certification process and cultural indicators, as well as a school evaluation. The questionnaire can be answered in approximately 30 minutes during a period that does not interfere with the student's lecture time.

You must know that:

1. Your participation is voluntary.
2. There are no anticipated risks to your participation. If you feel any discomfort when answering a question, please feel free to skip the question.
3. The answers you provide and your identity will be kept confidential. Your answers will only be reported in the aggregate.
4. This is an investigation for educational purposes.
5. Your participation will not take place during teaching time.

The results of the study will help determine new LEED socio-cultural indicators that could be developed as pilot credits, particularly for green schools in Puerto Rico.

You will not receive any direct benefit, beyond the satisfaction of having contributed to the improvement of the assessment tool for sustainable buildings in Puerto Rico. Any personal information you provide will NOT be disclosed.

It is important to acknowledge that the Puerto Rico Department of Education is relieved of any responsibility for any claim that may arise as a result of the study activities and the information requested and provided through it. The Department of Education of Puerto Rico is not responsible for any damage or loss or claim resulting from the process of completion, or the result of the investigation; it relieves of any obligation and responsibility to the Department of Education of Puerto Rico, its employees and officials in any claim or lawsuit that is directly or indirectly related to this investigation. This is an independent study not sponsored by the Department of Education of Puerto Rico. The Department of Education of Puerto Rico does not necessarily support the results of the investigation.

A copy of the informed consent will be filed in the school principal's office of your school. After the investigation is finished, results will be available for study in the Electronic Library of the University of Nottingham Trent and in the "Secretaría Auxiliar de Planificación y Desarrollo Educativo" at the Puerto Rico Department of Education main offices.

You have been explained your rights as a research participant. If you have additional

questions regarding the investigation or would like to request a copy of this document after completing it, you can contact me at eidilart@gmail.com.

Thank you in advance for taking the time to complete this survey.

Sincerely,

Arch. Eileen L. Díaz, LEED AP (BD+C)

1. Whether or not you agree to participate in this investigation, please indicate your decision:

Mark only one oval.

- I agree to participate in the study. (By selecting this option, you will proceed to the survey)
- I do NOT agree to participate in the study. (By selecting this option, you will proceed to exit the survey)

General

2. I am associated with the following school:

Mark only one oval.

<input type="radio"/>	<i>List case study school names</i>
<input type="radio"/>	

Other: _____

3. How many years have you been associated with this school?

Mark only one oval.

- Less than a year
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26-30 years
- Over 30 years

4. Years of experience in your discipline:

Mark only one oval.

- Less than a year
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26-30 years
- Over 30 years

5. My association with the school is:

Mark only one oval.

- School Principal
- Teacher (full time)
- Teacher (part time)
- Other: _____

Cultural Education

Definitions:

1. Culture is defined as the characteristics of a society, its norms, values, skills, knowledge, beliefs and aspirations that serve as a guide for an individual or group. Culture could also be interpreted as "way of life", including its customs, dress, cuisine, language, arts, science, technology, religion, and traditions (Axelsson et al., 2013; Dessein et al., 2015; Hawkes, 2001; Walker, 2014).

2. Cultural education introduces students to art and culture, promotes historical awareness, creativity and the formation of an individual identity (LKCA, 2017).

6. How is culture included in the curriculum and school programs? (Please select all that apply)

Check all that apply.

- Physical education courses
- Music courses
- Language courses
- Art courses
- History courses
- After school programs
- Student organizations
- Cultural events
- Other: _____

7. In what ways and how often do you use your green school building and grounds to teach about culture? (Ex.: Indoor or outdoor activities, exhibitions, music festivals, theater or drama performances, public speakers, among others)

Cultural Identity/
User Perception

Definitions:

1. Cultural identity refers to the sense of belonging of an individual or group with a common origin, history, ancestry, characteristics and/or ideals (Hall and Gay, 1996: 2-4, 6).

8. Which symbols of Puerto Rican culture are evident in the school?

Check all that apply.

- P.R. flag
- P.R. Coat of Arms or Seal
- Taino symbols
- Fauna (Ex. Coquí or other)
- Flora (Ex. Hibiscus flower ("flor de maga") or other)
- Jíbaro Puertorriqueño
- Popular arts (Ex. Wood carved figures or other)
- National Hymn (La Borinqueña)
- Proverbs or sayings
- P.R. Literature
- P.R. food (Ex. Cocina criolla)
- Typical Music and Dance (Ex. Danza, bomba y plena)
- Contemporary Music and Dance (Ex. Salsa, Urban music)
- Musical Instruments (Ex. Cuatro, guiro, maracas, congas, bomba drums or other)
- Myths and legends
- Holidays and festivities
- Other: _____

9. Which characteristics of Puerto Rican culture are evident in the school?

Check all that apply.

- Strong attachment to the land (Ex. School garden program)
- Close family connections: family as support system
- Bilingualism: speaking and understanding of both spanish and english languages
- "Spanglish" language: Mix of english and spanish used in everyday conversations
- Melting pot of cultures: Mixture of Indian, African, European and American traditions, customs and words
- Migrations and Diaspora: Student migration
- Relaxed attitude toward time
- Non verbal communication and behavior used in everyday conversations (Ex. gestures, facial expression, posture)
- P.R. as United States territory (Ex. Federal funding, compliance with federal laws and regulations, cultural assimilation, and others)
- Other: _____

10. When you see your school, which of the following words come to mind? (Please select all that apply)

Check all that apply.

- Progress
- Tropicality
- Modernity
- Tradition
- Puertoricanness
- Regionalism
- Sustainable or eco-friendly
- Other: _____

11. Do you think P.R.'s identity is adequately expressed in the school design? (Please explain)

12. What do you consider is unique about this school?

Example: Building design, curriculum, activity, personnel, location, views or other.

Leadership in Energy and Environmental Design (LEED) Certification Process

13. Were you involved in the Leadership in Energy and Environmental Design (LEED) accreditation process in your school?

Mark only one oval.

- Yes
- No *Skip to question 18*

14. Please comment on your role during the LEED certification process:

15. Level of satisfaction with the Leadership in Energy and Environmental Design (LEED) Accreditation process in your school? (Please explain in the blank next to "Other")

Check all that apply.

- Extremely satisfied
- Very satisfied
- Moderately satisfied
- Slightly satisfied
- Not satisfied
- Not sure
- Other: _____

16. In addition to the project team, who else was involved in the design and planning process of your sustainable school? (Please select all that apply)

Check all that apply.

- School Principal
- Teachers
- School support staff
- Parent/ Guardian
- Community members
- Maintenance/ facilities staff
- Sustainability consultant
- Other: _____

17. Do you think your sustainable school has brought awareness to students in the following aspects?

Mark only one oval per row.

	Yes	No	Not sure
Energy efficiency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water efficiency and conservation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Materials reuse	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Recycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alternate transport use (Ex. Bicycle, bus, carpool use)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local product consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Food production (Ex. School and home garden)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Cultural Indicators

18. Please rate how important it is for you that your sustainable school includes the following cultural aspects and if these are present in your school:

Cultural indicators for schools in P.R.

Mark only one oval per row.

	Important and currently implemented	Important but not present	Present but not important	Not important and not present
Cultural Diversity: Building encourages cultural exchange. Building hosts different cultures and respects and appreciates people with different backgrounds.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The building has spaces for cultural activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide a space for communal meals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction, passive recreation, and physical activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Joint Use of Facilities: To integrate the school with the community by sharing building spaces and its playing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

fields for non-school events and functions.

The building makes people feel a sense of place, belongingness and rootedness.

Learning environments and school culture foster creativity and innovation.

Aesthetic quality of the building: The project must contain design features intended solely for human delight and the celebration of culture and place appropriate to its function.

Neighborhood Facilities: Availability and access to cultural related establishments, venues or organizations in the surrounding community (Ex. museums, performing arts centers, artists' studios, parks, libraries, religious facilities hosting cultural programs, public spaces suitable for cultural activity, and/or cultural districts).

Impact of the school design on existing streetscapes.

Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.

Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.

Child involvement in afterschool arts and cultural programs

19. Please mention any additional cultural indicators that you think might be important for local schools and should be added to the list above?

Cultural Vitality: Opportunities/ Participation / Support

20. Which of the following spaces do you consider that contribute to the socio-cultural exchange between the school community members? Please check the box if the facility is present and if it is used for cultural activities.

Check all that apply.

	Facility present in school	Present AND Used for cultural Activities	Facility NOT present in school
Amphitheatre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Art room	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cafeteria	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Classrooms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Entrance piazza	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibition space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Faculty room	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hallway	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Library	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Patio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Performance spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shared community spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sports facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. Which of the following existing spaces or opportunities near the school do you consider that contributes to the socio-cultural exchange with the surrounding community?

Check all that apply.

- Coffee place
- Community Center
- Library
- Municipality Plaza
- Museum
- Park
- Restaurants
- Religious facilities
- Theater
- Cultural districts—including retail opportunities for arts consumption (Art galleries, stores and others)
- Ethnic-specific associations and organizations
- Organizations that support the arts-related (and other) activities to facilitate cultural exchange
- Temporary venues and events- recurrent (festivals, arts markets and others)
- Other: _____

22. Which of the following cultural aspects does the school promote/ facilitate/ support?

Check all that apply.

- Volunteer opportunities in arts and culture
- Explicit policies about arts and culture
- Integration of arts and culture into the curriculum
- Adequate public expenditure in support of arts and cultural activities
- Participation of school community members in cultural governance

23. Community Participation: Which of these aspects best describes the school and community relationship (Please select all that apply)

Check all that apply.

- School events open for the community
- School spaces leased for community events
- School used as storm shelter
- Community partnerships
- Parent- Teacher Association
- Student field trips to cultural places within the municipality
- Students perform community service
- Learning activities take place in the surrounding community
- Participation of community members in school governing bodies
- Other: _____

Place evaluation: Placemaking/ Use/
Perception

Please rate your school from 4 (Good) to
1(Poor)

24. Access & Linkages

Mark only one oval per row.

	4 (Good)	3	2	1 (Poor)	Not sure
Visibility from a distance (street presence)	<input type="radio"/>				
Clarity of information/signage	<input type="radio"/>				
Access to quality transit (Bus, train)	<input type="radio"/>				
Bicycle access and facilities in school	<input type="radio"/>				
Other	<input type="radio"/>				

25. Sociability and Participation

Mark only one oval per row.

	4 (Good)	3	2	1 (Poor)	Not sure
Fosters social interactions between people	<input type="radio"/>				
Promotes a sense of pride and ownership among community members (Identity and sense of belonging)	<input type="radio"/>				
Promotes school and community relations	<input type="radio"/>				
Participation of users and community leaders in decision making processes	<input type="radio"/>				
Other	<input type="radio"/>				

26. Uses and activities

Mark only one oval per row.

	4 (Good)	3	2	1 (Poor)	Not sure
Provision of spaces for socio-cultural activities	<input type="radio"/>				
Builds and supports local economy (Small scale entrepreneurship, economic development, promote higher real estate values)	<input type="radio"/>				
Health (Promotes increased physical activity by providing play and recreation facilities)	<input type="radio"/>				
Health (Access to fresh food, Ex. School garden)	<input type="radio"/>				
Other	<input type="radio"/>				

27. Comfort and image

Mark only one oval per row.

	4 (Good)	3	2	1 (Poor)	Not sure
Attractiveness	<input type="radio"/>				
Comfort of places to sit	<input type="radio"/>				
Quality views	<input type="radio"/>				
Feeling of safety in the school	<input type="radio"/>				
Other	<input type="radio"/>				

Adapted from: Project for public spaces- Place Game (PPS, 2005); Community Placemaking in Dumfries and Galloway (Dumfries and Galloway Council, 2016).

General Information

28. Ethnicity:

Mark only one oval.

- Hispanic or Latino (Puerto Rican)
- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander

29. To which gender identity do you most identify?

Mark only one oval.

- Male
- Female
- Prefer not to answer
- Not listed

Thank you for taking the time to complete this survey.

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APPENDIX D: METHODOLOGY MATRIX

Methodology Matrix: (Re) Measuring (LEED) Sustainability: From a Global Rating System to Tropical Specificity				
Survey/ Interviews: Architects, Engineers and Sustainability Consultants Sample: Architects and sustainability consultants of the 8 LEED certified schools in P.R.				
Research Objectives	Topic	Strategy/ Methodology	Target	Reference
1. To inform how and determine if the U.S. LEED certification program addresses social and cultural elements as sustainability indicators.	Leadership in Energy and Environmental Design (LEED) Certification Process	<p>Literature Review</p> <p>Survey questions: Are you a Leadership in Energy and Environmental Design (LEED) Professional?</p> <p>Were you involved in the LEED accreditation process in your school?</p> <p>Level of satisfaction with the Leadership in Energy and Environmental Design (LEED) Accreditation process in your school? (Please explain in Other)</p> <p>In addition to the project team, who else was involved in the design and planning process of your sustainable school? (Please select all that apply)</p> <p>Do you think LEED targets the</p>	<p>N/A</p> <p>Architect Engineer Sustainability Consultant</p> <p>Architect Engineer Sustainability Consultant</p> <p>Architect Engineer Sustainability Consultant</p> <p>Architect Engineer Sustainability Consultant</p>	(Barr, 2011)

		<p>following sustainability dimensions?</p> <p>Do you think LEED is an adequate tool for measuring sustainability in Puerto Rico? (Please explain in "Other")</p>	<p>Architect Sustainability Consultant</p> <p>Architect Sustainability Consultant</p>	
<p>2. To analyse why and propose how LEED indicators and regionalization initiatives by the USGBC could be modified to respond effectively to the tropical context of P.R.</p>		Literature Review	N/A	
<p>3. To identify what aspects of sustainability in the tropical Caribbean P.R. region are excluded from LEED but could be incorporated as indicators.</p>	<p>Cultural Indicators for schools in P.R.:</p> <p>Categories: Cultural Communication/ Economy/ Education/ Governance Cultural Heritage/ Cultural Inclusion and Participation Cultural Spaces and Events</p>	<p>Please rate how important it is for you that sustainable schools in Puerto Rico include the following cultural aspects:</p>	<p>Architect Sustainability Consultant</p>	<p>Cultural indicators from literature review (Rosario Jackson et al., 2006; UNESCO, 2014; Wu et al., 2016) and the following Sustainable Assessment Systems: RESET (UIA, 2012); LEED V4 (BD+C, O+M, ND) (USGBC, 2019); Living Building Challenge 3.0 (USGBC,</p>

				2019); SB Tool 2015-16 (iiSBE, 2015); SPeAR (Arup, 2012); DGNB Offices (“German Sustainable Building Council (DGNB),” 2014); SBAT Residential 1.04 (CSIR, 2015) and Green Star Australia (GBCA, 2017).
	Culture and Placemaking Design intention	<p>Which of the following architectural styles influenced your sustainable school design, if any? (Please select all that apply)</p> <p>Please mention any architects or architectural projects that influenced your sustainable school design, if any?</p> <p>What aspects from your culture informed the school design? (Please select all that apply)</p> <p>Which architectural elements employed in the school design contribute to the expression of Puerto Rican culture: (Please select all that apply)</p> <p>Was your school designed as a storm shelter?</p>	Architect	(Parsaee et al., 2015; Project for Public Spaces, 2007)

		<p>Please select any features that enable your sustainable school to be an ideal storm shelter? (Please select all that apply)</p> <p>Interview questions: What architectural concept and sources of inspiration informed the school design?</p> <p>Do you think your school design influences the culture of the building occupants? How? (Please explain)</p>		
	<p>Cultural Identity/ Design Intention</p> <p>Cultural Identity/ Design Intention/ User Perception</p>	<p>Which symbols of Puerto Rican culture were incorporated in the school design?</p> <p>When you see your school, which of the following words comes to mind? (Please select all that apply)</p> <p>What do you consider is unique about this school?</p> <p>Interview questions: In what way is P.R.'s cultural identity expressed in the school design?</p>	<p>Architect</p> <p>Architect</p> <p>Architect</p> <p>Architect</p>	(Duany)
	Place evaluation: Placemaking	What sources of "placemaking" informed the school design?	Architect	Adapted from: Project for public spaces- Place

		(Please select all that apply)		Game (PPS, 2005); Community Placemaking in Dumfries and Galloway (Dumfries and Galloway Council, 2016).
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APPENDIX E: SCHOOL SAS GLOSSARY/ DESCRIPTION

School SAS name	Description
<p>International SAS</p> <p>Building Research Establishment Environmental Assessment Method (BREEAM)</p>	<p>Launched in 1990, BREEAM was the first building certification system (BRE, 2022). Even though it was conceived in the United Kingdom, it is currently used worldwide in over 70 countries (Rics.org, 2015). Also, it has served as reference to more recent assessment systems such as Green Star, RESET, among others (Cole and Valdebenito 2013: 665, “Reset,” n.d.: 15).</p> <p>BREEAM targets mainly three dimensions of sustainability, namely social, environmental and economic. This investigation will reference BREEAM International New Construction (NC) and In-Use, which are applicable to schools. Only the BREEAM In Use (Asset) system includes one (1) indicator identified as cultural and is related to the future adaptation of buildings. Also, includes social sustainability aspects such as the health and comfort of building users and neighbours, indoor air quality, safety and security, stakeholder engagement and accessibility (Taylor and Ward, 2016:5).</p>
<p>Green Globes</p>	<p>Green Building Initiative (GBI) is a nonprofit organization and an American National Standards Institute (ANSI) Accredited Standards Developer. In 2004, GBI adapted Green Globes- Canada, to the U.S. market (GBI, 2022). This SAS targets mainly the environmental dimension and includes several social indicators (2-5 indicators in NC and EB, respectively). The Existing Buildings version includes one (1) economic indicator. No cultural indicators were identified in the analysis.</p>
<p>Living Building Challenge (LBC)</p>	<p>The Living Building Challenge (LBC) advocates for a change in lifestyle since 2006. In contrast to other SAS that are focused on minimizing impact on the environment, the LBC is a performance based standard that “calls for the creation of building projects at all scales that operate as cleanly, beautifully and efficiently as nature’s architecture” (ILFI, 2015). The International Living Future Institute (ILFI), has an aspiring mission: “lead the transformation to a world that is <u>socially just, culturally rich and ecologically restorative</u>” (ILFI, 2022).</p> <p>The LBC is a “tool for regenerative design”, that is comprised of seven performance categories known as <i>Petals</i>: Place, Water, Energy, Health & Happiness, Materials, Equity and Beauty (ILFI, 2022). The Social Equity petal promotes equal access and fair treatment to all human beings regardless of their age, socioeconomic status, race, gender or disabilities and endorses the development of human-scaled spaces that promote culture and interaction.</p> <p>The LBC is one of the few SAS that includes Beauty as a category, with the intention that a project’s design features and public art appropriate to its function, culture, spirit and place, may educate and encourage people to preserve or conserve their surroundings. The “Biophilic Environment” indicator within the Health & Happiness Petal, further reinforces the concept that the project’s design must strengthen the connection between human beings,</p>

	nature, history, local climate and culture through “Place-based Relationships” (ILFI, 2014:40).
Sustainable Building (SB) Tool	<p>The Sustainable Building (SB) Tool, formerly known as GBTool, was developed in 1995 by the International, non-profit organization, Initiative for a Sustainable Built Environment (iiSBE). This SAS is built upon a general flexible framework that can be adjusted to suit almost any location and project (iiSBE, 2009). The weighting and scope of the system can be modified from 6 to 120 criteria, as needed, depending on regional conditions.</p> <p>This system targets the largest number of both social and cultural indicators, out of the temperate systems analysed. Cultural categories and credits include:</p> <ul style="list-style-type: none"> ○ Social, Cultural and Perceptual Aspects: Includes indicators such as Compatibility of urban design with local cultural values; Impact of the design on existing streetscapes; Use of traditional local materials and techniques; as well as Maintenance of the heritage value and aesthetic quality of an existing facility (iiSBE, 2015).
Context- climate specific SAS	
Building and Construction Authority’s (BCA) Green Mark (GM)	<p>The Green Mark (GM) system, launched in 2005 in Singapore, has been described as the “tropics’ answer” to LEED because it places higher emphasis on passive design for energy efficiency (Building and Construction Authority, n.d.: 9). The GM 2015 Rating System analysed for this study, includes social benefit criteria such as spatial quality; air quality and user comfort that can be found under the “Smart & Healthy Buildings” section. Also, under the “Advanced Green Building Efforts” section, projects can earn credits by developing initiatives that promote occupant engagement and wellbeing such as the integration of urban farming and community gardens, among others (BCA, 2015b:205).</p> <p>GM recognizes that the definition of social benefits can vary depending on the project context and may include aspects such as community welfare, improving workers’ conditions, stimulating the local economy, as well as promoting local labour and craft. To demonstrate compliance, the project team must submit a description of the proposed initiatives, intended social benefits and lessons learned (BCA, 2015b:205). However, no cultural indicators were identified in this SAS.</p>
Green Rating for Integrated Habitat Assessment (GRIHA)	<p>The GRIHA was developed in 2007 by the Energy and Resources Institute (TERI) and endorsed by the Ministry of New and Renewable Energy, Government of India. However, the Association for Development and Research of Sustainable Habitats (ADaRSH) is the non-profit organization, responsible for administering the GRIHA system and awarding the final rating (Ministry of New and Renewable Energy, 2012: 26). In addition to the New Construction scheme applicable to educational facilities, GRIHA-Prakriti was developed to evaluate the environmental performance of existing day schools in India.</p> <p>These schemes include categories such as Occupant comfort and well-being, as well as Socio-economic strategies, social initiatives, among others. Indicators include labour safety and sanitation, design for universal accessibility, dedicated facilities for service</p>

	<p>staff and increase in environmental awareness. Also, the Occupant Comfort and Well Being category requires that hygienic conditions be maintained in schools. No cultural indicators were identified in this SAS.</p>
<p>Requirements for Sustainable Buildings in the Tropics (RESET)</p>	<p>RESET was initially developed by the Institute of Tropical Architecture in Costa Rica and passed on to the College of Architects of Costa Rica and Institute for Technical Norms (INTECO), so that it could become a national standard (“Reset,” n.d.: 15). According to Bruno Stagno, Director of the Institute of Tropical Architecture, RESET was “designed for use in the Tropics taking into account the socioeconomic, environmental and climatic characteristics of the region” (UIA, 2012: 2). The standards call for moderation in building technology use, while promoting design, bioclimatic strategies and architectural form as means to achieve sustainability (UIA, 2012: 6).</p> <p>While LEED still has the market share in Costa Rica, RESET continues to differentiate itself from its competition by providing a SAS tool designed by architects that emphasizes on relevant sociocultural, economic, spatial and passive design strategies to achieve sustainability in the tropics.</p> <p>RESET requires teams to adapt their architectural solutions and plans to the socio-cultural context, through the preparation and application of the results of a sociological study into the project (UIA, 2012:25). The “Environment and Transport” category also encourages the integration of the project to the community, its cultural and natural surroundings through design.</p> <p>The “Spatial Quality and Well Being” (21.67%) category has the highest number of points while the Energy Optimization has the lowest (7.50%). This is different than LEED, where Energy has the highest criteria weighting. The Spatial quality category favours user's comfort through passive means; the design of pro-environment spaces that encourage social interaction and mediate between interior and exterior. Also, advocates for a spatial design that takes into consideration the architectural typology of the region.</p>

Compatible systems that include cultural indicators

In addition to analysing international School SAS, this research evaluated other compatible systems with cultural indicators deemed relevant for educational facilities:

Compatible SAS name	Description
Temperate zone SAS	
DGNB	<p>The DGNB CORE14 scheme for new offices, developed by the German Sustainable Building Council and the General Federal Ministry of Transport, Building and Urban Affairs (BMVBS), is available for international use. Other schemes, such as the “new educational buildings” rating system, are not considered in this investigation because are not yet available in English at the time of analysis and would have to be combined with CORE14 to be used Internationally (“German Sustainable Building Council (DGNB),” n.d.).</p> <p>Includes relevant categories such as:</p> <ul style="list-style-type: none"> • “Sociocultural and Functional Quality”: deals with health, user comfort and satisfaction, safety, accessibility and public art.

JUST	The JUST label promoted by the U.S. International Living Future Institute, also developers of the LBC, is a voluntary certification program for socially just and equitable organizations. Companies disclose information about their operations, social initiatives and policies, including how they treat their employees and where they make financial and community investments. JUST includes an online database that demonstrates an organization’s level of compliance with the following indicators: diversity, equity, safety, stewardship, local and worker benefit (ILFI, 2022 ; Intl. Living Future Institute, 2014).
Sustainable Project Appraisal Routine (SPeAR)	SPeAR is a “sustainability decision-making tool”, developed by the international architectural firm ARUP (2022). Includes a social category that deals with stakeholder engagement, community facilities; health and safety; social participation and culture (Arup, 2012). Culture is included as part of the social category and includes identity; local heritage; intergenerational and gender practices; art; archaeology; cultural and religious facilities.
Compatible tropical systems (mostly for residential and/ or commercial use)	
Casa Azul	Casa Azul, seal of “ <i>Caixa Econômica Federal</i> ” in Brazil, contains sociocultural indicators in the following categories (Caixa, 2010): <ul style="list-style-type: none"> • Social practices: Promotes education, community participation in the project’s development & social inclusion (cultural activities, literacy), as well as employment creation. • Design comfort: Includes a Leisure, Social and Sporting Spaces indicator to encourage cultural, social and recreational user interactions that promote a Sense of Place.
PCES	The PCES system, promoted by the Mexican Government for offices and residences incorporates sociocultural indicators under the Quality of life and Social Responsibility category. Includes indicators that promote Accessibility, cultural participation in sustainability; and the design of green areas to provide comfort and foster social interaction (“PCES,” 2010).
Tropical Green Building Certification Program (TGBC)	The Residential Tropical Green Building Certification Program (TGBC) by the Island Green Living Association for St. John, St. Thomas and St. Croix, U.S. Virgin Islands (USVI), is currently the only Caribbean SAS. This system is more focused on design criteria to promote adequate views, passive strategies, as well as protection from natural hazards such as hurricanes, which are common in the region (IGLAVI, n.d.).
SAS from the Subtropical region were also included in the analysis, due to a high content of sociocultural indicators	
Green Star Australia: Communities	The Green Star Australia: Communities developed by its Green Building Council, includes cultural issues in the following categories: <ul style="list-style-type: none"> • Governance: Engagement and community participation • Liveability: culture, heritage and identity Also, includes a credit library titled “Innovation Challenges”, similar to LEED Pilot Credits, that serve as means to propose new indicators and test them. These include Community Benefits, Culture, Heritage and Identity (Green Building Council of Australia, 2015).

Green Star South Africa: Socioeconomic Category	This pilot program entails a separate certification or credits that can be used for innovation points and includes 7 possible indicators: Employment Creation; Economic Opportunity; Skills Development & Training, Community Benefit, Empowerment, Safety & Health (GBC South Africa, 2014:xii). Future research could explore this implementation strategy for the proposed LEED cultural indicators resulting from this research.
Sustainable Building Assessment Tool (SBAT)	The Residential Sustainable Building Assessment Tool (SBAT) was developed by the South African Council for Scientific and Industrial Research (CSIR), particularly for a developing country context (CSIR, 2015). To support sustainable development, it includes the following sociocultural indicators: <ul style="list-style-type: none"> • Access to basic products and services • Education: Internet access and spaces for learning • Inclusion: Affordability and accessibility • Social Cohesion: Communal Spaces, Neighbourhood Facilities and community participation

APPENDIX F: CODING MANUAL (EXTRACT)

A Coding Manual was developed for this research to ensure consistency and objectivity during the [re] categorization of indicators process, inspired by Bryman (2012:300) methodology. Table 1 presents an extract from the coding manual, particularly the *Social Equity and Environmental Justice* IC in Owens et al. (2013). Each LEED indicator or metric was classified under its applicable sustainability dimension (cultural, environmental, economic, social) (Tier 1). This served as guide to classify the list of indicators in SAS worldwide under each IC (Tier 2) and Component (Tier 3). Comments were included on the right column as guide for classifying the indicators under each respective category.

Table 1: LEED V4: DETAILED IMPACT CATEGORY AND COMPONENTS											
IMPACT CATEGORY & DEFINITION (TIER 2)	KEY INDICATORS OR COMPONENTS (TIER 3)	LEED INDICATORS OR METRICS REFERENCED (Owens et al., 2013)	LEED			OTHER SAS	SUST. DIMENSIONS (TIER 1)				COMMENTS & REFERENCES TO OTHER SAS INDICATORS
			ND	SCHOOLS			CULT	ECON	ENV	SOC	
				NC	OM						
SOCIAL, CULTURAL, ENVIRONMENTAL, ECONOMIC (This IC has components in all four sustainability pillars)											
Enhance Social Equity, Environmental Justice, Community Health and Quality of Life: <ul style="list-style-type: none"> ○ support the long-range vision for the future growth and community development ○ provide universally accessible 	Create a Strong Sense of Place	light pollution reduction;	X	X	X				X		LEED credit intent: "To minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction and reduce development impact from lighting on nocturnal environments." Does not mention Sense of place on the credit narrative. Should be included or refocused if it is one of its

<p>economic opportunities, supports environmental justice and human rights, addresses issues of social equity,</p> <ul style="list-style-type: none"> ○ improve quality of life ○ nurture cultural vitality ○ buildings can shape the culture, politics, values, prosperity, health, and happiness of citizens 												goals		
													Classified under Environmental> Social Equity...> Sense of place. It could also be included in biodiversity, local habitat protection.	
	tree-lined streets;	X										X	Hide parking	
	views;		X	X	X	X								RESET
	landscaping and green roofs;		X									X		
open spaces; civic spaces;	X	X				X					X	X	<p>Civic spaces include public streets, squares and parks.</p> <p>This component focuses on:</p> <p>CULTURAL: Open space compatible with local cultural values.</p> <p>ENVIRONMENTAL: Habitat preservation, runoff</p> <p>SOCIAL: Access to nature/ place. Community benefit.</p> <p>OVERLAP- Repeated in Access to Neighborhood Completeness Resources but focuses on the availability of open and civic spaces.</p>	
historic preservation;	X				X	X							RESET	

		connection to the outdoors;				X				
		walkable communities;	X					X	X	
		human scale environments;			X	X				RESET; Form and Space> Density, height, scale and massing> SPeAR
		cultural expression; freedom to express values/beliefs through building design			X	X				Also includes aesthetic quality of the project and the inclusion of art and design features that celebrate culture, spiritual enrichment (SB Tool; LBC); the use of traditional materials and techniques (SB Tool), as well as the integration of the project to the surrounding context (SB Tool, RESET). Placemaking strategies.
		<i>[++] community participation in decision making processes and governance</i>				X			X	
	Provide Affordable, Equitable and Resilient Communities	affordable housing and jobs proximity;	X				X	X	X	ENVIRONMENTAL: Impact on access to daylight or solar energy potential of adjacent property (SB Tool) OVERLAP- SOCIO-ECONOMIC: ECONOMIC: Pay scale equity (applies to organizations as well) (JUST)

										green cleaning (LEED)
					X				X	Drinking water as a human right
			X	X	X			X		ENVIRONMENTAL: IAQ, Noise control, acoustics
		X			X				X	Advanced green efforts>Social benefits (Green Mark): Submit a description of the initiatives or the project and how it contributes to social sustainability
					X			X		Sample indicators: <ul style="list-style-type: none"> • Service Quality category>Construction safety (SB Tool) • Waste 05: Functional Adaptability: Bldg. is flexible; allows future changes (BREEAM NC). • Climatic Responsive Design > Spatial Quality and Internal Organization (Green Mark) • Materials 05: Designing for Durability and Resilience (BREEAM)
					X			X		-Resiliency included in LEED Reli, and one of LEED v.4.1 revised goals.

Table 2: Sustainability Dimensions, Impact Category and Components

The table above includes the four (4) sustainability dimensions (cultural, environmental, economic, social), as well as their respective Impact Category and Components based on Owens et al. (2013). The table below presents the final list of IC and components classified under each sustainability dimension, utilizing the Excel software.

Cultural
Social Equity, Env. Justice...
Access to neighborhood resources
Affordable, equitable and resilient communities
Human rights & env. justice
Sense of Place
Economic
Greener Economy
GB products & services
GB Value
Growth & investment
Industry and supply chain
Support local economy
Social Equity, Env. Justice...
Affordable, equitable and resilient communities
Environmental
Biodiversity
Global biodiversity, habitat protection & land preservation
Local biodiversity, habitat protection & open spaces
Sustainable use & management of ecosystem services
Climate Change
Clean energy supply
Embodied energy
Energy use
Global warming potential
Transport
Material & Resources
Cyclical, non-depleting material cycles
Quality
Raw material extraction
Reduce negative env. impact
Social Equity, Env. Justice...
Access to neighborhood resources
Human rights & env. justice
Sense of Place
Water Resources
Natural hydrological cycle
Water conservation
Water quality
Social
Health & wellbeing
Comfort & wellbeing
Exposure to negative health impacts
Social Equity, Env. Justice...
Access to neighborhood resources
Affordable, equitable and resilient communities
Human rights & env. justice
Sense of Place

Key for understanding Table 2: The coding process was organized as follows:

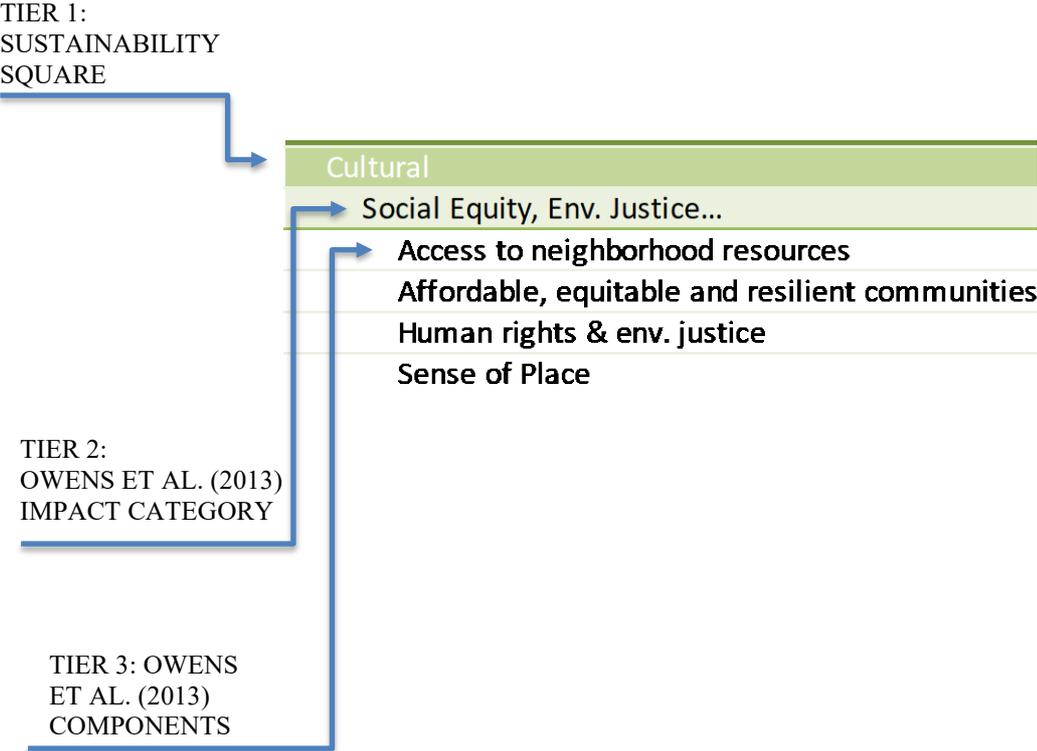


Table 2: **Extract from the Cultural sustainability dimension, Social Equity IC**

Extract from the Cultural sustainability dimension, *Social equity, environmental justice, community health and quality of life IC, Promote Access to Neighbourhood Completeness Resources* component and a list of indicators worldwide classified under that category.

Cultural
Social Equity, Env. Justice...
<u>Access to neighborhood resources component</u> (list of indicators worldwide classified under that category):
<ul style="list-style-type: none"> • Access to civic & public space • Activity related to recreational arts practice such as enrollment in arts training programs and membership in arts clubs or leagues • Audience participation in different kinds of cultural venues • Availability of establishments, venues or arts-related organizations (e.g., museums, performing arts centers, artists' studios) in the surrounding community. • Availability of ethnic associations or ethnic-specific business establishments offering or hosting cultural programs in the surrounding community. • Availability of parks, libraries and/or churches hosting cultural programs in the surrounding community. • Availability of short-term and episodic cultural venues and events such as festivals, or arts and craft markets • Collective art-making practice vis-à-vis participation in festivals or other cultural community events • Communal Space where occupants of the building can be seated for communal meals. • Community Facilities: Recreation: The provision of community facilities should take into consideration the technology, construction, maintenance and management of services, and should be appropriate to the project's context. • Covered neighbourhood facilities available for community events • Cultural and religious facilities • External neighbourhood facilities: Open space that is available for community events • Form and Space • Formal and informal cultural districts, and neighborhoods where artists congregate • Integrate the project into its surroundings through design: Encourage cultural identity; social cohesion; integration of the project in the community and harmony with the cultural and natural environment. • Joint Use of Facilities: To integrate the school with the community by sharing the building and its playing fields for nonschool events and functions. • Membership in professional arts associations or unions

-
- Open Space: Create exterior space that encourages interaction with the environment, social interaction, passive recreation, and physical activities.
-
- Provision of public open space compatible with local cultural values.
-
- Parks and libraries offering or hosting cultural programs
-
- Participation in going-out cultural activities (Ex. cinema, theatre, concerts or live performances, museum, historical/cultural park or heritage site, among others)
-
- Participation in identity-building cultural activities (Ex. national or local festivals; community celebration of cultural/ historic events; community rites, events or ceremonies)
-
- Presence of arts-related organizations (e.g., museums, performing arts centers, artists' studios) in the surrounding community.
-
- Public spaces especially suitable for cultural activity in the surrounding community.
-
- The building (and/or its surrounding site) has public spaces for cultural activities.
-
- The building site has a mixed pattern of land use, with dynamic community activities when applicable.
-
- Web-based opportunities for cultural engagement specific to the place in question
-

APPENDIX G: CULTURAL SUSTAINABILITY COMPONENTS AND INDICATORS INCLUDED ON SURVEY TO DESIGN AND CONSTRUCTION PROFESSIONALS

Cultural Sustainability Components and Indicators					
Cultural Vitality Components	Thematic analysis	Proposed cultural indicators included on survey (Extract from survey)	LEED	OTHER SAS	References
Cultural communication	Access and internet use; human rights: freedom of speech; diversity of media content	27.1. Access to the internet (cultural and creative content)			(Rosario Jackson et al., 2006; UNESCO, 2014:12; United Cities and Local Governments, 2008:5)
		27.2. Freedom of expression: Ability for all individuals to enjoy the right and opportunity to speak, write, and create			
Cultural economy	Contribution of cultural activities to the Gross Domestic Product (GDP); cultural industries and employment; cultural funding; respect rights of authors and fair remuneration	27.3. Public expenditure in support of arts and cultural activities			Rosario Jackson et al., 2006; UNESCO, 2014:12; United Cities and Local Governments, 2008
		27.4. Amount of money spent by school community members on cultural activities, goods, and services			
		27.5. Philanthropic expenditures in support of arts and culture			
		27.6. Academic Integrity			
Cultural education	Professional training in culture (inclusive, multilingual, arts)	28.1. Multilingual Education (teaching of two or more languages)			Rosario Jackson et al., 2006; UNESCO, 2014:12
		28.2. Professional Training in cultural and creative fields			
		28.3. Arts Education is included in the curriculum.			
		28.4. Child involvement in afterschool arts and cultural programs			
Cultural governance	Standards and policies; assessment mechanisms; distribution of cultural infrastructures; civil society participation & joint responsibility	28.5. Explicit public policies about arts and culture			Rosario Jackson et al., 2006; UNESCO, 2014:12; United Cities and Local Governments, 2008
		28.6. Participation of school members in cultural governance			
		28.7. Administer a Post- Occupancy Cultural Evaluation to school members			

Cultural heritage	Includes both tangible and abstract qualities. <ul style="list-style-type: none"> • Tangible: "material signs handed on by the past to each culture" (Ex. Architecture monuments, Art, Archaeological, Human made landscapes, Intellectual works); Historical preservation • Abstract: Practices, representations, knowledge, skills, instruments, artefacts, and spaces 	29.1. Impact of the school design on existing streetscapes		X	Axelsson et al., 2013:217; Kroeber and Kluckhohn, 1952; UNESCO, 2014:12, 1989, 1972; Williams, 1995:11; Wu et al., 2016 Other SAS: Green Star; SB Tool; SPeAR;
		29.2. The building reflects collective memories and protects the local history and character of a place			
		29.3. Encourage the adaptive reuse of school buildings and cultural landscapes	ND		
		29.4. Raise awareness of the building's heritage value among the school community and general public		X	
		29.5. Respecting socio- cultural identity and context		X	
		29.6. The building involves traditional materials, craftsmanship and techniques		X	
Cultural inclusion & participation	Access to culture; participation in cultural activities; freedom of self-determination	30.1. Collective art-making practices and purchase of artistic materials			Rosario Jackson et al., 2006; UNESCO, 2014:12; United Cities and Local Governments, 2008:6
		30.2. Volunteering and personal support of arts and cultural activity			
		30.3. Enrolment in arts training programs and membership in arts associations			
		30.4. Participation in cultural activities			
		30.5. Freedom of self- determination: evaluates individuals' sense of empowerment to decide and live the life they choose.			
		30.6. Gender equality: equal opportunities and rights between women and men			
Cultural spaces & events	diversity of cultural expressions; interculturality; public spaces as cultural spaces; aesthetic quality of the building; public art and design features	31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds			Axelsson et al., 2013: 217; United Cities and Local Governments, 2008:6; Walker, 2014:12; Wu et al., 2016
		31.2. Availability of short- term and episodic cultural venues and events [...]			
		31.3. The building has spaces for cultural activities			
		31.4. Provide a space for communal meals		X	
		31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction [...]	SC		

Cultural components (capabilities, tools and skills): creativity, critical knowledge, sense of place	31.6. Joint Use of Facilities: Share school building spaces and its playing fields with the community [...]	SC		Other SAS: SBAT; SB Tool; LBC
	31.7. Integrate public art and local artists in the school [...]		X	
	31.8. Biophilic Environment: How the project will be uniquely connected to the place, climate and culture through Place- Based Relationships [...]		X	
	31.9. The building makes people feel a sense of place, belongingness and rootedness.			
	31.10. The building is designed with adaptability [...]		X	
	31.11. Learning environments and school culture foster creativity and innovation.			
	31.12. Spiritual enrichment: The building (and/or its surrounding site) encourages the inner development and spirituality [...]		X	
	31.13. Aesthetic quality of the building.		X	
	31.14. Neighborhood Facilities: Availability and access to cultural related establishments, venues or organizations.	ND		

Key: LEED for Schools (SC); LEED for Neighbourhood Development (ND)

APPENDIX H: LEED SCHOOLS: CASE STUDY SELECTION MATRIX

ID	New Construction	Remodeled	LEED (BD+C Schools)		LEED Cert. Level (Points Achieved/Max.)				Year Certified (2000's)				Educ. type		Grade Level	Sq. Ft.	No. of students 2020-21	
			v2.2	v3	Cert.	Silver	Gold	Plat.	13	14	15	16	Trad.	Voc.				
Puerto Rico Department of Education - Regions I & II																		
A	X			X			64/110			X				X		K-8	116,402	547
B	X			X			53/110		X					X		PK-5	71,880	356
C	X			X			54/110			X				X		PK-8	143,860	653
D	X			X			63/110					X		X		K-12	89,149	424
E	X		X				39/69			X				X		K-8	72,000	542
Other Puerto Rico Department of Education Regions																		
F		X					43/110			X				X		9-12	89,688	731
G	X						44/110		X					X		K-12	16,948	135
H		X					56/110				X			X		6-12	62,501	372
I	X						64/110				X			X		9-12	196,195	1,304
J*	X													X		K-8	84,400	460
N=10 schools. (Data sources: NCES, 2021; USGBC, 2016)																		

APPENDIX I: ETHICS APPROVAL LETTERS

NOTTINGHAM
TRENT UNIVERSITY

Professor Michael White
Nottingham Trent University
50 Shakespeare Street
Nottingham NG1 4FQ
Tel: +44 (0)115 848 2069
Email: michael.white@ntu.ac.uk

25 February 2020

To whom it may concern

I am pleased to inform you that the Art, Architecture, Design and Humanities College Research Ethics Committee (AADH - CREC) have approved the [Re] Measuring [LEED] Sustainability which will be run by Eileen Daiz-Lamboy.

If you have any further queries regarding the AADH - CREC, it's methods and procedures or related to this project, then please do not hesitate to contact me.

Yours sincerely

Michael J White

Professor Michael White
Chair of the Art, Architecture, Design and Humanities College Research Ethics Committee
(AADH - CREC)

Nottingham Trent University
50 Shakespeare Street, Nottingham NG1 4FQ
Tel. +44 (0)115 941 8418
www.ntu.ac.uk

University,
reimagined

Approval letter from the AADH Research Ethics Committee- Nottingham Trent University

RE: Ethical approval update

Dear Eileen

I am delighted to inform you that your application for an extension to Extension - (Re)Measuring (LEED) Sustainability: From a Global Rating System to Tropical Specificity has been approved by Chair's Action on behalf of the AADH Research Ethics Committee.

On behalf of the Committee I would like to wish you continued success with this project.

Best wishes

Sarah Dossor

Research Governance & REF Coordinator

Research Operations

Nottingham Trent University

Login to [Worktribe](#) to get a costing, expert advice, formal approvals and more. Access support information, latest news and training dates on the Worktribe [NOW Learning Room](#).

[Research Operations SharePoint](#)

Follow us on Twitter: @NTUNews



University of the Year 2019
The Guardian University Awards

TEF Gold Teaching Excellence Framework



Approval letter from the AADH Research Ethics Committee- Nottingham Trent University (10/28/2020). An extension to the original protocol was filed to conduct a focus group and/or 2nd round of semi-structured interviews.

INSTITUTIONAL COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS
IN RESEARCH BOARD (IRB-UPR CAROLINA)

University of
Puerto Rico
at Carolina



Subject : Protocol Approval “[Re]Measuring LEED Sustainability: from a global rating system to tropical Specificity”

To : Prof. Eileen L. Díaz Lamboy
Principal Investigator

Protocol No. : 002-2019-20

The Institutional Review Board for the Protection of Human Subjects in Research (IRB of the University of Puerto Rico in Carolina) has made the following determination, upon your request for research with human participants. The application has been evaluated with the corresponding reviews:

X APPROVED: You are authorized to conduct your research.

This approval is valid for **one (1) year**, from this notification. **This expires on February 27, 2021.**

If you need additional time to complete your investigation, **you will need to request an extension before the expiration date of this authorization.** For the extension, please observe the following steps:

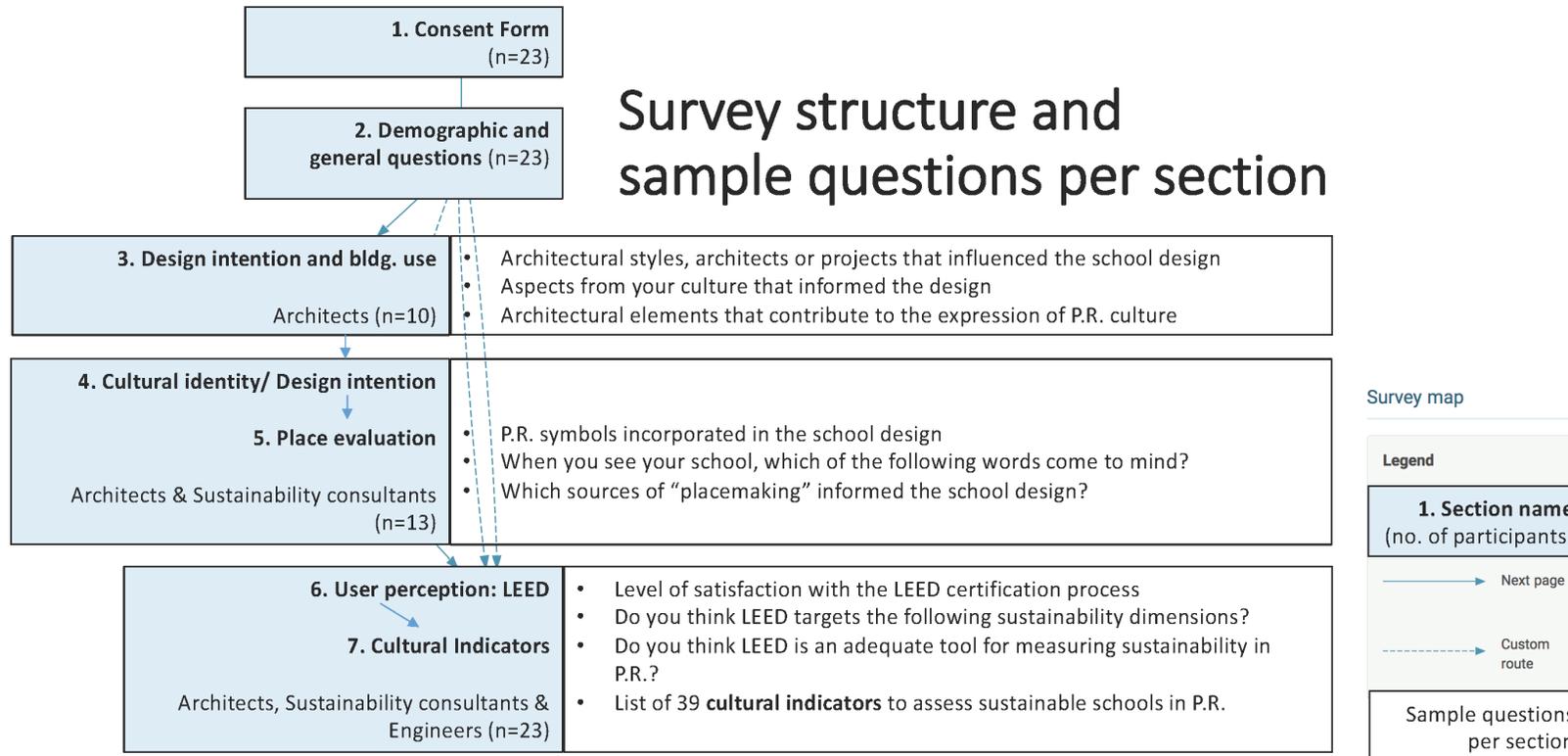
- ✓ Explain in a written report submitted to IRB-UPRCA:
 - Research summary
 - Reasons that have not allowed you to conclude your investigation
 - The phase of the investigation
 - An estimated time to conclude the investigation
 - Explain, in detail, how many participants are missing to be selected, how many have already been recruited and the reasons for the loss of participants, if any.
 - Certify that you will continue with the same procedures approved by IRB-UPRCA.
 - Report if there were any unexpected adverse events or other relevant information.
 - Renew online training on the research with human subjects.

- ✓ For any changes to the research proposal, **you must:**
 - Report to IRB-UPRCA, so that this Board can evaluate the changes that has been incorporated for its approval.
 - Submit the proposal to IRB-UPRCA for approval.
 - The new proposal **should include** changes to the procedures and consent sheet in blackened letters (“**Bold**”).

Deanship of
Academic Affairs
Research &
Multidisciplinary
Center
IRB-UPRCA

Extract from approval letter by the Institutional Review Board for the Protection of Human Subjects in Research of the University of Puerto Rico in Carolina.

APPENDIX J: SURVEY MAP



Survey map: Includes section name, number of professionals that answered each part and sample questions per section.

APPENDIX K: DESIGN AND CONSTRUCTION PROFESSIONALS CONSENT FORM, BLANK SURVEY INSTRUMENT AND SUMMARY OF SURVEY RESPONSES

Survey: (Re) Measuring (LEED) Sustainability

Consent Form: Architects, Engineers and Sustainability
Consultants

Green Schools: Cultural Evaluation

Description

You are invited to participate in the research project titled [Re] Measuring [LEED] Sustainability, which I am developing, as part of my doctoral studies at Nottingham Trent University (NTU) in the United Kingdom. The aim of this study is to identify socio-cultural factors in Puerto Rico (P.R.) that could be incorporated as indicators in the Leadership in Energy and Environmental Design (LEED) green building certification system for the particular case of schools, in order to adequately adapt this system to the tropical context.

We are asking you to participate in this survey, because you were an architect, engineer or sustainability consultant in one of the eight (8) LEED certified schools that were part of the Schools for the 21st Century Program in the Island. The target population includes approximately 30 people.

Your participation will consist in answering a questionnaire that includes a series of questions about culture and the LEED certification process of the school you worked on. The questionnaire can be answered in approximately 20 minutes. If you are available for a follow up interview, please indicate it on the survey.

Risks and benefits

Your participation does not involve any risks other than what you would encounter in daily life. If you are uncomfortable with any of the questions or topics, you are free not to answer. You will not receive any direct benefit, beyond the satisfaction of having contributed to the improvement of the assessment tool for sustainable buildings in Puerto

Rico.

Confidentiality

Personal information or data that can identify you directly or indirectly will be handled confidentially. Unless required by law, only the study investigator and NTU supervisory team have the authority to review your records.

Results of this study may be used for teaching, research, publications and presentations at professional meetings. If your individual results are discussed, then a code number will be used to protect your identity. Anonymized data may be used in other studies in line with the University Research Data Management Policy.

NTU is committed to respecting the ethical codes of conduct of the United Kingdom Research Councils (RCUK) and the European Union General Data Protection Regulation (EU GDPR). Thus, in accordance with established procedures, the University will conserve all information and data collected during the research in line with University Policy, consistent with both RCUK, and the EU GDPR (<https://www.ukri.org/about-us/policies-and-standards/gdpr-and-research-an-overview-for-researchers/>).

Data will be kept confidential and in a secure place for 6 years, after the research is finished, in line with the Research Data Management Policy and destroyed in line with the current RCUK/University/GDPR Guidelines.

Rights

If you read this document and decided to participate, please understand that your participation is voluntary and that you have the right to refrain from participating or withdraw from the study, without penalty. If you wish to withdraw your consent please contact me before March 15, 2020. Also, you are invited to keep a copy of this document for your records.

If you have any questions or would like more information about this investigation, please contact Arch. Eileen L. Díaz (787-948-7864 or eidilart@gmail.com) or the research supervisor Dr. Marisela Mendoza (marisela.mendoza@ntu.ac.uk).

If you want to speak with someone who is not directly involved in this research, or if you have questions about your rights as a research subject, contact Professor Michael White, Chair for the College Research Ethics Committee (CREC) for the College of Art Architecture Design and Humanities (CAADH) at NTU. You can send an e-mail to

michael.white@ntu.ac.uk.

Thank you in advance for taking the time to complete this survey.

Whether or not you agree to participate in this investigation, please indicate your decision: * *Required*

- I agree to participate in the study. (By selecting this option, you will proceed to the survey)
- I do NOT agree to participate in the study. (By selecting this option, you will proceed to exit the survey)

Demographic and General Questions

Age group:

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

To which gender identity do you most identify?

- Male
- Female
- Prefer not to answer
- Not listed

Ethnicity:

- Hispanic or Latino (Puerto Rican)
- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander

I am associated with the following LEED certified school:

List case study school names

[Note: If you participated in the design and construction of more than one school, please select the project where you were most involved.]

Years of experience in your discipline:

- Less than a year
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21-25 years
- 26-30 years
- Over 30 years

My role in the school construction, renovation or remodeling:

- Architect
- Architect in Training
- Sustainability Consultant
- Engineer
- Other

If you selected Other, please specify:

Culture and Placemaking

Definitions:

Culture is defined as the characteristics of a society, its norms, customs, values, skills, knowledge, beliefs and aspirations that serve as a guide for an individual or group (Axelsson et al., 2013; Dessein et al., 2015, p. xiv; Hawkes, 2001, p. 3; Walker, 2014).

Which of the following architectural styles influenced your sustainable school design, if any? (Please select all that apply)

- Postmodern architecture
- Modern architecture
- American- prairie style
- International style
- Tropical architecture
- Biomimetic architecture
- Vernacular architecture
- Spanish colonial architecture
- Other

If you selected Other, please specify:

Please mention any architects or architectural projects that influenced your sustainable school design, if any?

What aspects from your culture informed the school design? (Please select all that apply)

- History
- Religion
- Ideology (Ideas that constitute one's goals, expectations and actions; beliefs or principles)
- Traditions and customs
- Beliefs (confidence or trust in someone or something)
- Ideals (a standard of perfection; a principle to be aimed at)
- Other

If you selected Other, please specify:

Which architectural elements employed in the school design contribute to the expression of Puerto Rican culture: (Please select all that apply)

- Circulation
- Space organization and sequence
- Functional areas
- Distribution of public/ private zones
- Climatic features
- Building configuration
- Proportions and scale
- Material and color
- Ornaments and details
- Non-visual qualities
- Mix of architectural styles
- Other

If you selected Other, please specify:

Was your school designed as a storm shelter?

- Yes
- No

Please select any features that enable your sustainable school to be an ideal storm shelter? (Please select all that apply)

- Rainwater collection
- Solar panels
- Flexible layout
- Strong structure
- Bathroom equipped with showers
- Storm shutters
- Other

If you selected Other, please specify:

Cultural Identity/ Design Intention

Definitions:

Cultural identity refers to the sense of belonging of an individual or group with a common origin, history, ancestry, characteristics and/or ideals (Hall and Gay, 1996: 2-4, 6).

Which symbols of Puerto Rican culture were incorporated in the school design?

- P.R. flag
- P.R. Coat of Arms or Seal
- Taíno symbols
- Fauna (Ex. Coquí or other)
- Flora (Ex. Hibiscus flower ("flor de maga") or other)
- Jíbaro Puertorriqueño
- Popular arts (Ex. Wood carved figures or other)
- National Hymn (La Borinqueña)
- Proverbs or sayings
- P.R. Literature
- P.R. food (Ex. Cocina criolla)
- Typical Music and Dance (Ex. Danza, bomba y plena)
- Contemporary Music and Dance (Ex. Salsa, Urban music)
- Musical Instruments (Ex. Cuatro, guiro, maracas, congas, bomba drums or other)
- Myths and legends
- Holidays and festivities
- Other

If you selected Other, please specify:

When you see your school, which of the following words come to mind? (Please select all that apply)

- Progress
- Tropicality
- Modernity
- Tradition
- Puertoricanness
- Regionalism
- Sustainable or eco-friendly
- Other

If you selected Other, please specify:

Place evaluation: Placemaking

Definition:

Placemaking aims to strengthen the connection between people and places, focuses on citizen ownership and capitalizes on local community assets. Advocates for an inclusive design process, promoting community participation (PPS 2009).

Access & Linkages: What sources of “placemaking” informed the school design?
(Please select all that apply)

- Visibility from a distance (street presence)
- Clarity of information/signage
- Access to quality transit (Bus, train)
- Bicycle access and facilities in school
- Other

If you selected Other, please specify:

Sociability and Participation: What sources of “placemaking” informed the school design? (Please select all that apply)

- Foster social interactions between people
- Promote a sense of pride and ownership among community members (Identity and sense of belonging)
- Promote school and community relations
- Collaborative (Participation of users, architects and community leaders in decision making processes)
- Other

If you selected Other, please specify:

Uses and activities: What sources of “placemaking” informed the school design?
(Please select all that apply)

- Provision of spaces for socio-cultural activities
- Health (Promote increased physical activity by providing play and recreation facilities)
- Health (Access to fresh food, Ex. School garden)
- Build and support local economy (Small scale entrepreneurship, economic development, promote higher real estate values)
- Other

If you selected Other, please specify:

Comfort and image: What sources of “placemaking” informed the school design?
(Please select all that apply)

- Attractiveness
- Comfort of places to sit
- Quality views
- Feeling of safety in the school
- Other

If you selected Other, please specify:

Design: What sources of “placemaking” informed the school design? (Please select all that apply)

- Form supports function
- Adaptability (Adapts to changes in use. Ex. Changeable modular structure, reconfigurable sliding walls)
- Inclusivity (Accessibility, places everyone can use)
- Context-specific design
- Trans-disciplinary (Crosses boundaries of two or more disciplines)
- Transformative impact (Inspire leaders to make investments that generate social and economic benefit)
- Other

If you selected Other, please specify:

Leadership in Energy and Environmental Design (LEED) Certification Process

Are you a Leadership in Energy and Environmental Design (LEED) Professional?

- Yes, LEED Accredited Professional (AP)
- Yes, LEED Green Associate (GA)
- In progress
- No, but I am familiar with it
- No, I have no idea what it is

Were you involved in the Leadership in Energy and Environmental Design (LEED) accreditation process in your school?

- Yes
- No

Level of satisfaction with the Leadership in Energy and Environmental Design (LEED) Accreditation process in your school? (Please comment in the blank below)

- Extremely satisfied
- Very satisfied
- Moderately satisfied
- Slightly satisfied
- Not satisfied
- Not sure
- Other

Please comment (optional)

--

In addition to the project team, who else was involved in the design and planning process of your sustainable school? (Please select all that apply)

<input type="checkbox"/> School Principal <input type="checkbox"/> Teachers <input type="checkbox"/> School support staff <input type="checkbox"/> Parent/ Guardian <input type="checkbox"/> Community members <input type="checkbox"/> Maintenance/ facilities staff <input type="checkbox"/> Sustainability consultant <input type="checkbox"/> Other
--

If you selected Other, please specify:

--

Do you think LEED targets the following sustainability dimensions?

Environmental	Please select ▼
Economic	Please select ▼
Social	Please select ▼
Cultural	Please select ▼

Do you think LEED is an adequate tool for measuring sustainability in Puerto Rico?
(Please explain in the blank below)

- Yes
- No
- Not sure
- Other

Please explain in the blank below.

Cultural Indicators for Schools in Puerto Rico

Cultural Communication/ Economy: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

Please don't select more than 1 answer(s) per row.

	Very Important	Important	Somewhat Important	Not Important
Access to the internet, particularly for cultural and creative content.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Freedom of expression: Ability for all individuals to enjoy the right and opportunity to speak, write, and create, among others.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public expenditure, at the Dept. of Education of P.R. and/or School level, in support of arts and cultural activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amount of money spent by school community members on cultural activities, goods and services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Philanthropic expenditures in support of arts and culture (Ex. charitable giving to cultural entities).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Academic Integrity: Raise awareness on plagiarism, academic ethics and scholarly values.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Cultural Education/ Governance: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

Please don't select more than 1 answer(s) per row.

	Very Important	Important	Somewhat Important	Not important
Multilingual Education (teaching of two or more languages)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Training in cultural and creative fields (Ex. design, music, arts and cultural management, among others).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Arts Education is included in the curriculum.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child involvement in afterschool arts and cultural programs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Explicit public policies about arts and culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participation of school members in cultural governance (Ex.: formulation and implementation of cultural policies and programs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Administer a Post- Occupancy Cultural Evaluation to school members to inquire about cultural communication, education, governance, economy, participation, heritage, spaces and events.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Cultural Heritage: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

Please don't select more than 1 answer(s) per row.

	Very Important	Important	Somewhat important	Not important
Impact of the school design on existing streetscapes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The building reflects collective memories and protects the local history and character of a place.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Respecting socio- cultural identity and context: Projects should help to enhance local culture, habits and traditions, while accepting that it may sometimes be appropriate to work to help to change the culture of any given locality.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The building involves traditional materials, craftsmanship and techniques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Cultural Inclusion and Participation: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

Please don't select more than 1 answer(s) per row.

	Very Important	Important	Somewhat Important	Not important
Collective art- making practices and purchase of artistic materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Volunteering and personal support of arts and cultural activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Enrollment in arts training programs and membership in arts associations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Participation in cultural activities (Ex: cinema, theatre, concerts museum, historical/cultural park and festivals, among others.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Freedom of self- determination: evaluates individuals' sense of empowerment to decide and live the life they choose.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gender equality: Provision and perception of equal opportunities and rights between women and men in terms of education and labor force participation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Cultural Spaces and Events: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

Please don't select more than 1 answer(s) per row.

	Very Important	Important	Somewhat Important	Not important
Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of short- term and episodic cultural venues and events (Ex. festivals, arts and craft markets).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The building has spaces for cultural activities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide a space for communal meals.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Integrate public art and local artists in the school (Ex. exhibits).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Biophilic Environment: How the project will be uniquely connected to the place, climate and culture through Place-Based Relationships: Provision of human- nature interactions in both the interior and exterior of the project.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The building makes people feel a sense of place, belongingness and rootedness.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The building is designed with adaptability (Where possible, buildings allow further development and allow internal spaces and layouts to be modified).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Learning environments and school culture foster creativity and innovation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spiritual enrichment: The building (and/or its surrounding site) encourages the inner development and spirituality of humans (Ex. meditation spaces and programs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aesthetic quality of the building	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neighborhood Facilities: Availability and access to cultural related establishments, venues or organizations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Would you be inclined to have a follow-up interview?

Yes
 No
 Not sure

Final page

Thank you for taking the time to complete this survey!

Key for selection options

25.1.a -

Yes
No
Not sure

25.2.a -

Yes
No
Not sure

25.3.a -

Yes
No
Not sure

25.4.a -

Yes
No
Not sure

Powered by: JISC Online Surveys

SUMMARY OF PARTICIPANT SURVEY RESPONSES



Online surveys

Survey: (Re) Measuring (LEED) Sustainability

Showing 22 of 22 responses

Showing **all** responses

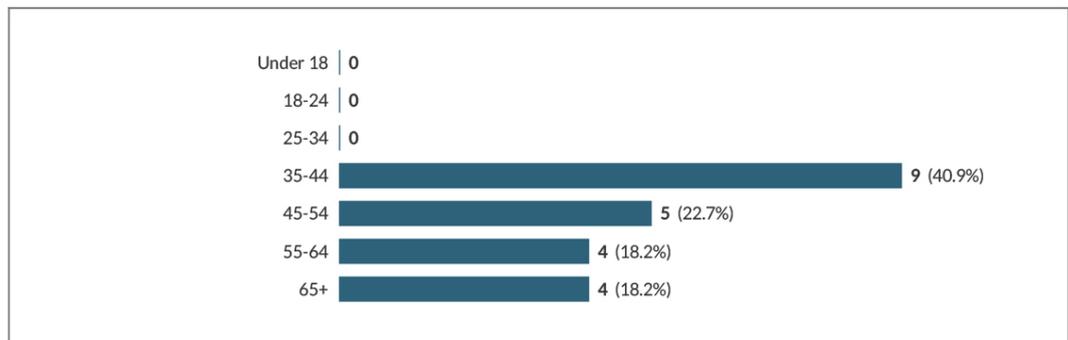
Showing **all** questions

Response rate: 75%

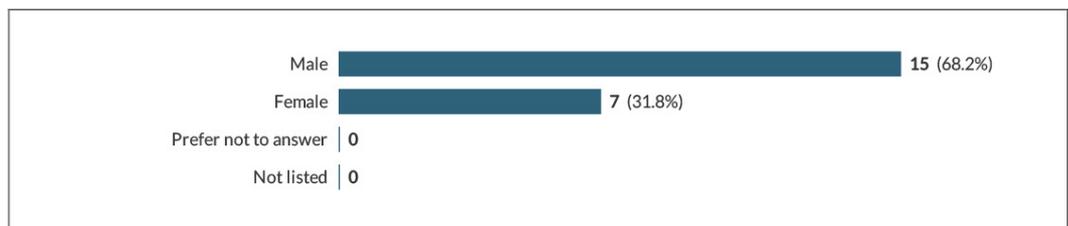
1 Whether or not you agree to participate in this investigation, please indicate your decision:



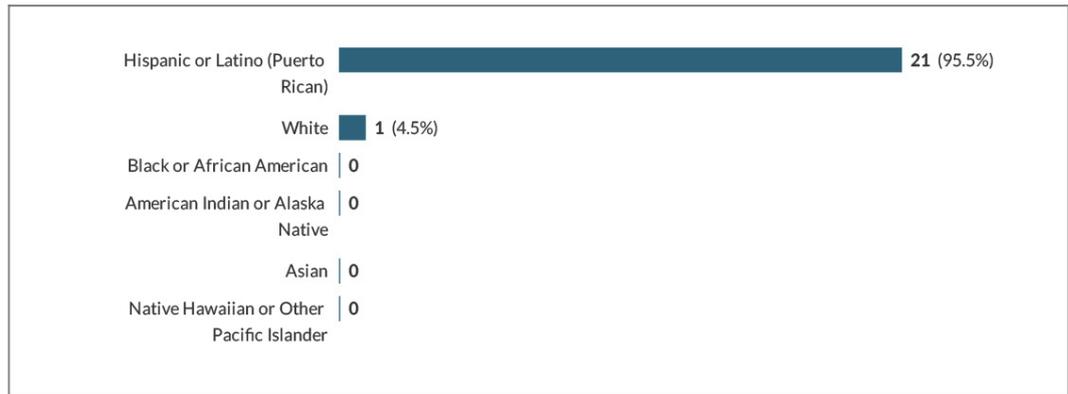
2 Age group:



3 To which gender identity do you most identify?

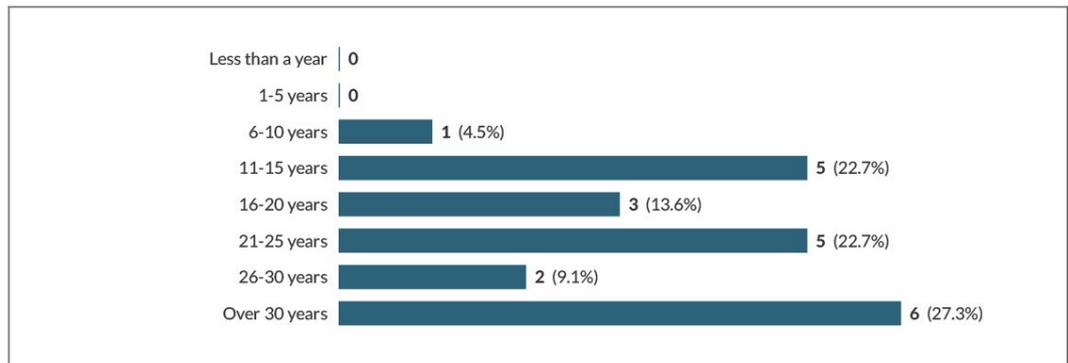


4 Ethnicity:

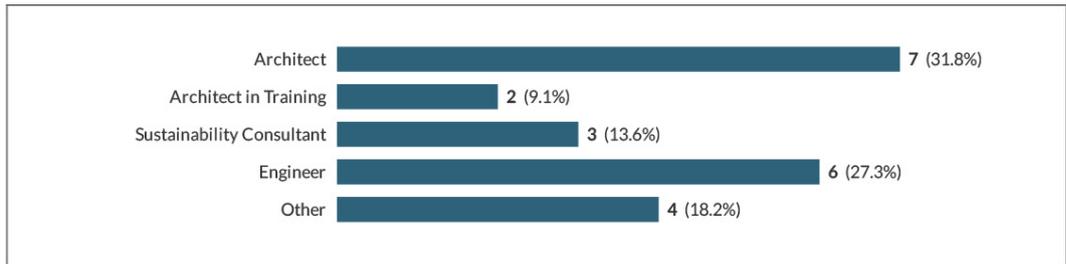


5 I am associated with the following LEED certified school:

6 Years of experience in your discipline:



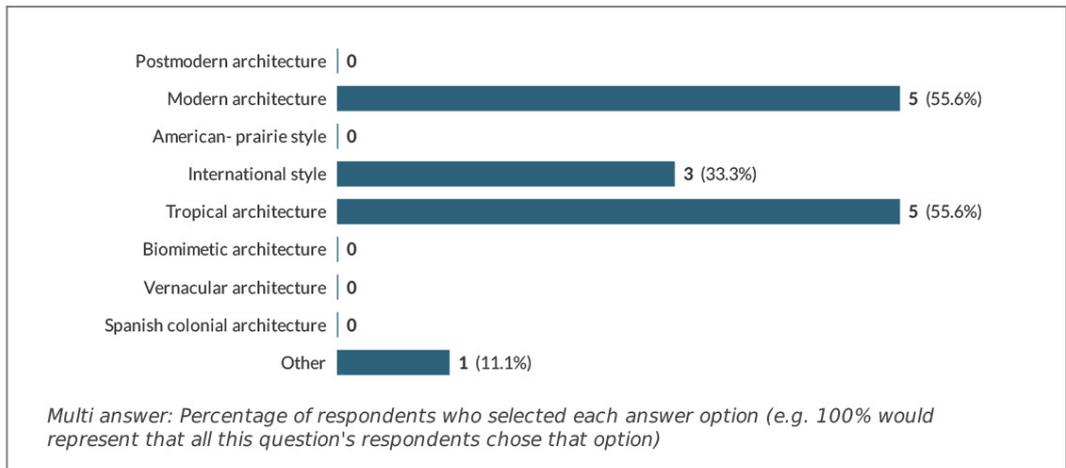
7 My role in the school construction, renovation or remodeling:



7.a If you selected Other, please specify:

Showing all 4 responses	
Water Resources Engineer - Consultant	572027-572018-56223051
Commissioning Agent	572027-572018-56541869
Design Builder	572027-572018-57091513
Project Manager, LEED Certification Manager	572027-572018-57091844

8 Which of the following architectural styles influenced your sustainable school design, if any? (Please select all that apply)



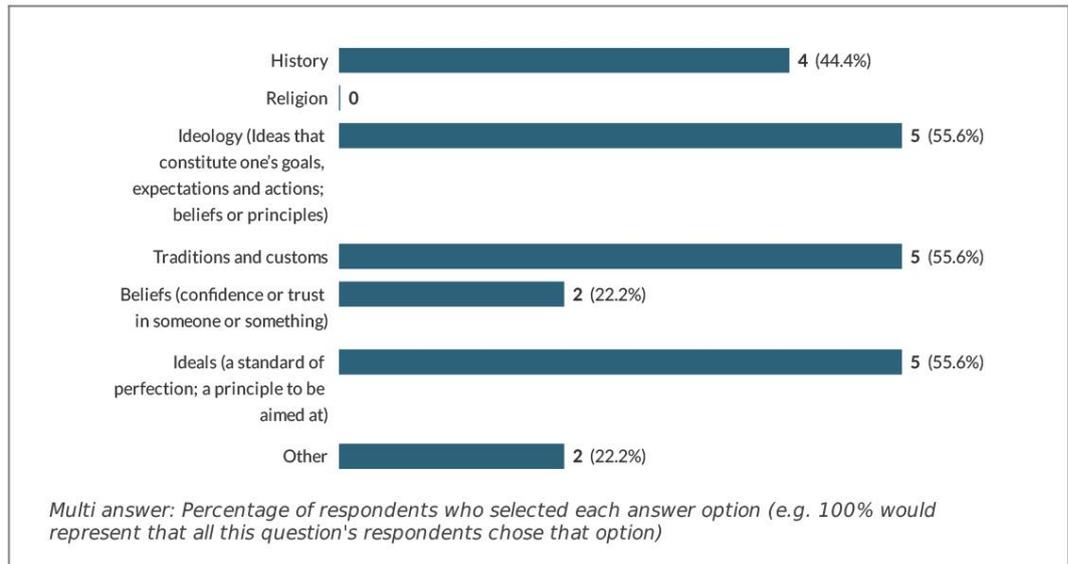
8.a If you selected Other, please specify:

Showing 1 response	
Post-Decon	572027-572018-57091125

9 Please mention any architects or architectural projects that influenced your sustainable school design, if any?

Showing all 3 responses	
Henry Klumb	572027-572018-56451111
We studied a few successful LEED Certified Schools located in the US, especially some close to the ocean such as Chartell School, Seaside California.	572027-572018-56649526
Escuela Bernardino Cordero Santiago, Ponce (Project also designed by this office)	572027-572018-57090573

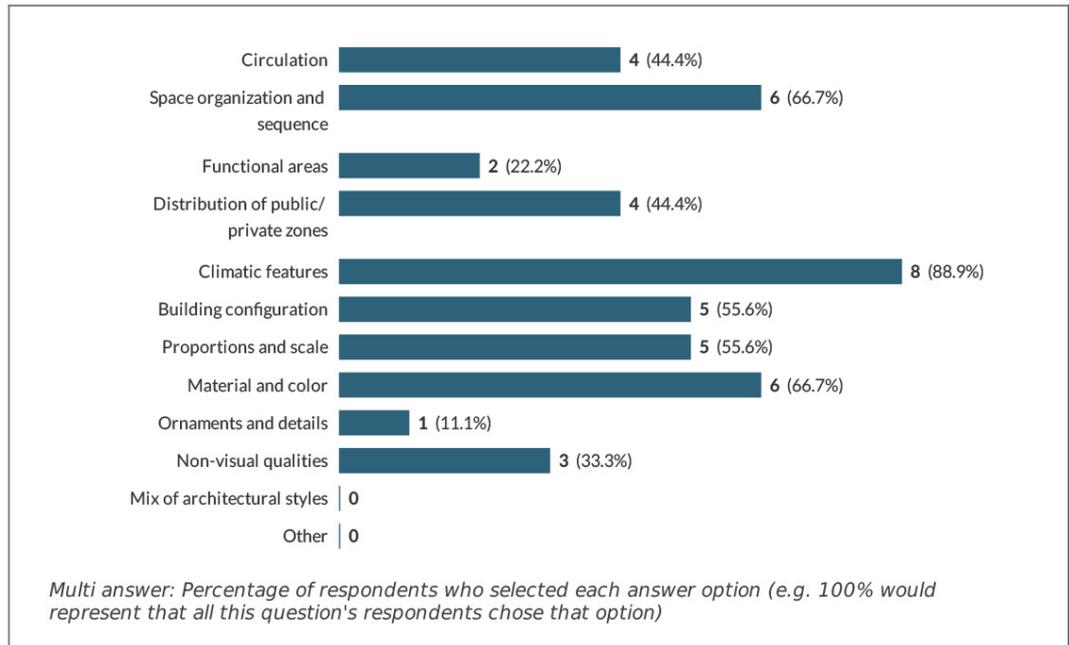
10 What aspects from your culture informed the school design? (Please select all that apply)



10.a If you selected Other, please specify:

Showing all 2 responses	
Scope of work, time and budget, program and square footage defined by Department of Education & AFI	572027-572018-56649526
Typology	572027-572018-57088783

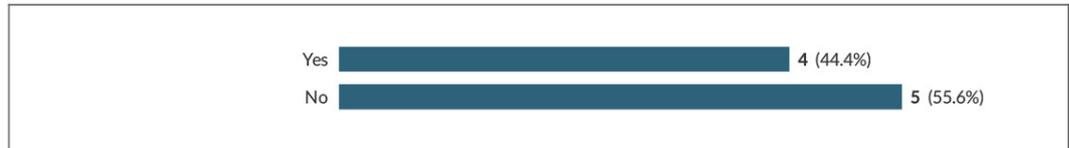
11 Which architectural elements employed in the school design contribute to the expression of Puerto Rican culture: (Please select all that apply)



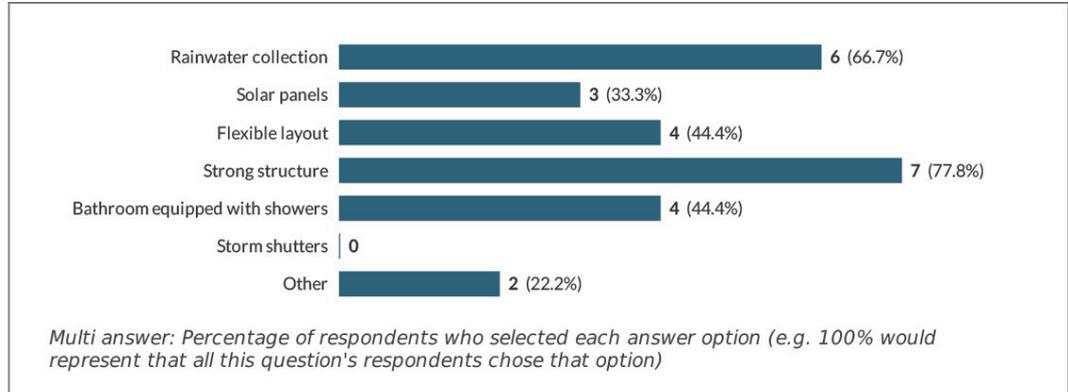
11.a If you selected Other, please specify:

No responses

12 Was your school designed as a storm shelter?



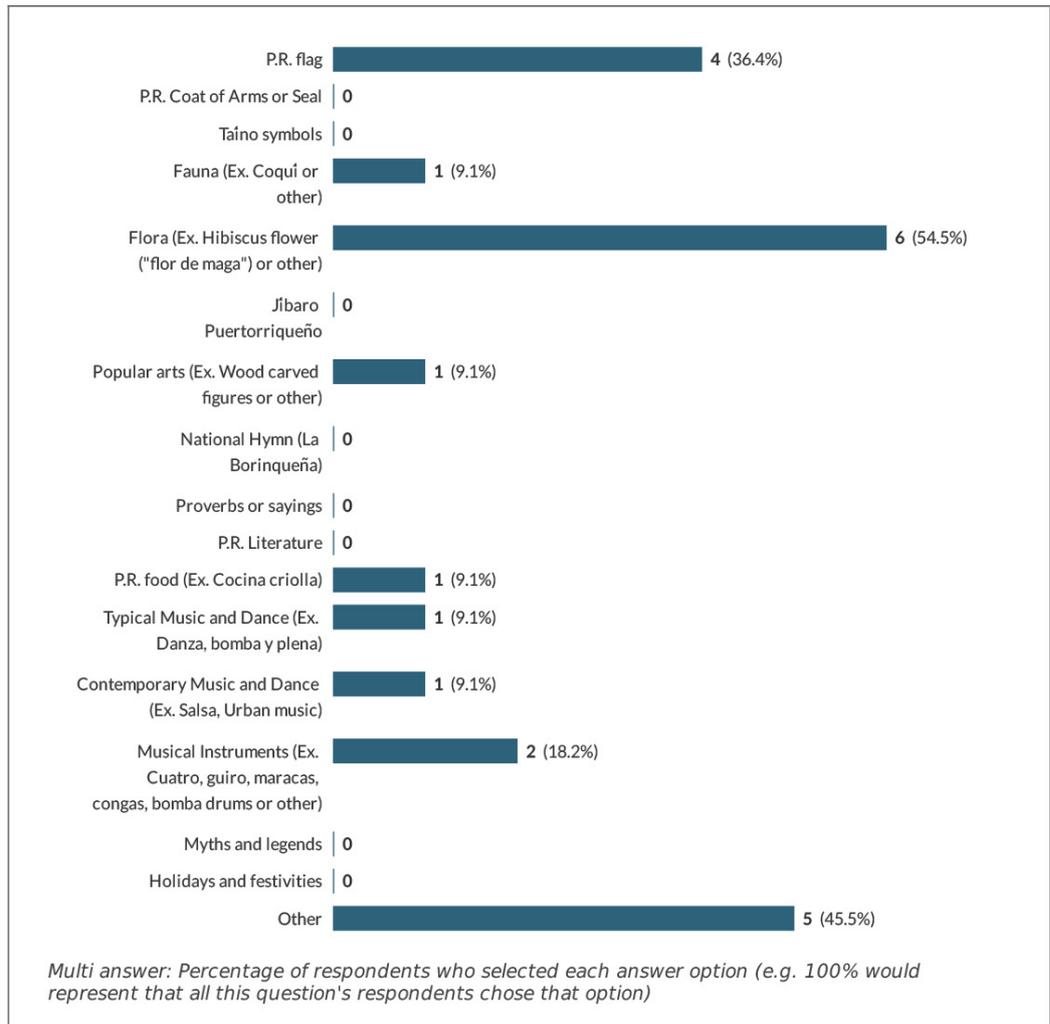
13 Please select any features that enable your sustainable school to be an ideal storm shelter?
(Please select all that apply)



13.a If you selected Other, please specify:

Showing all 2 responses	
Solar Water Heaters	572027-572018-57089206
Not applicable	572027-572018-57090573

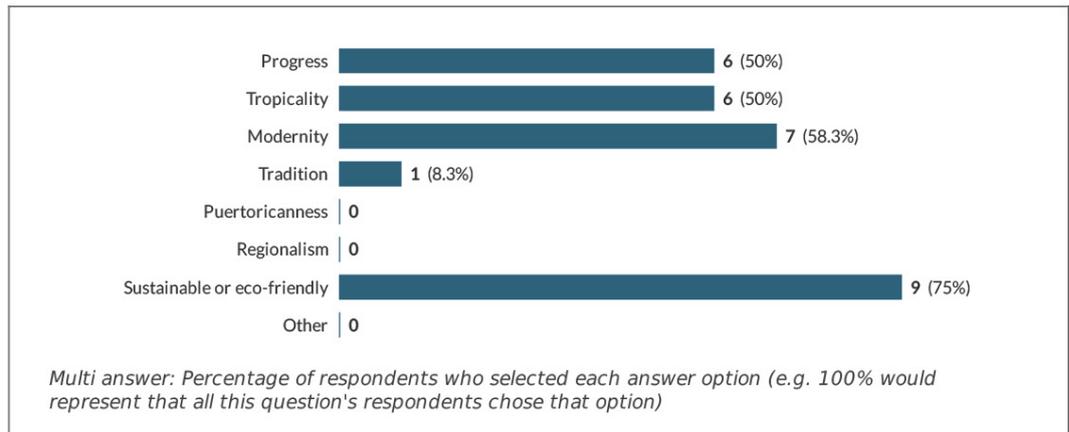
14 Which symbols of Puerto Rican culture were incorporated in the school design?



14.a If you selected Other, please specify:

Showing all 5 responses	
Views to the surrounding mountains	572027-572018-56451111
The flag is requisite, I don't remember any of these symbols being incorporated on the design per se.	572027-572018-56645806
Sports	572027-572018-56649526
Architectural details and childhood motifs	572027-572018-57089714
None	572027-572018-57091125

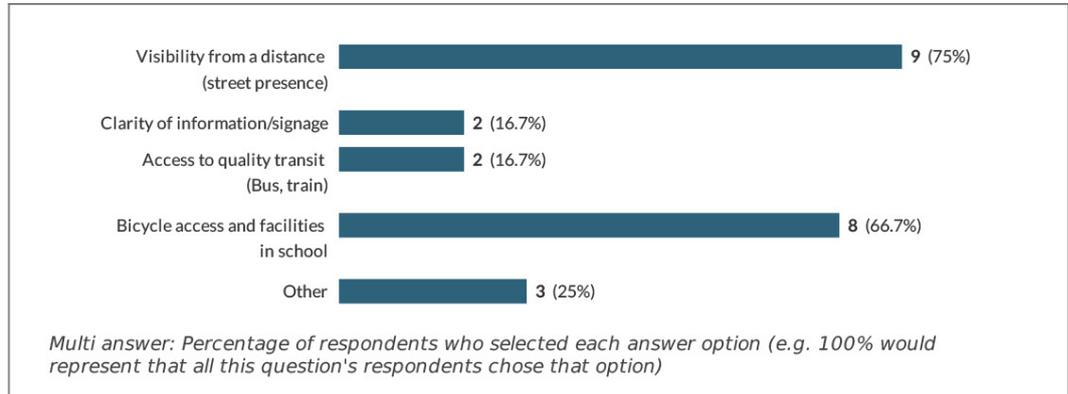
15 When you see your school, which of the following words come to mind? (Please select all that apply)



15.a If you selected Other, please specify:

No responses

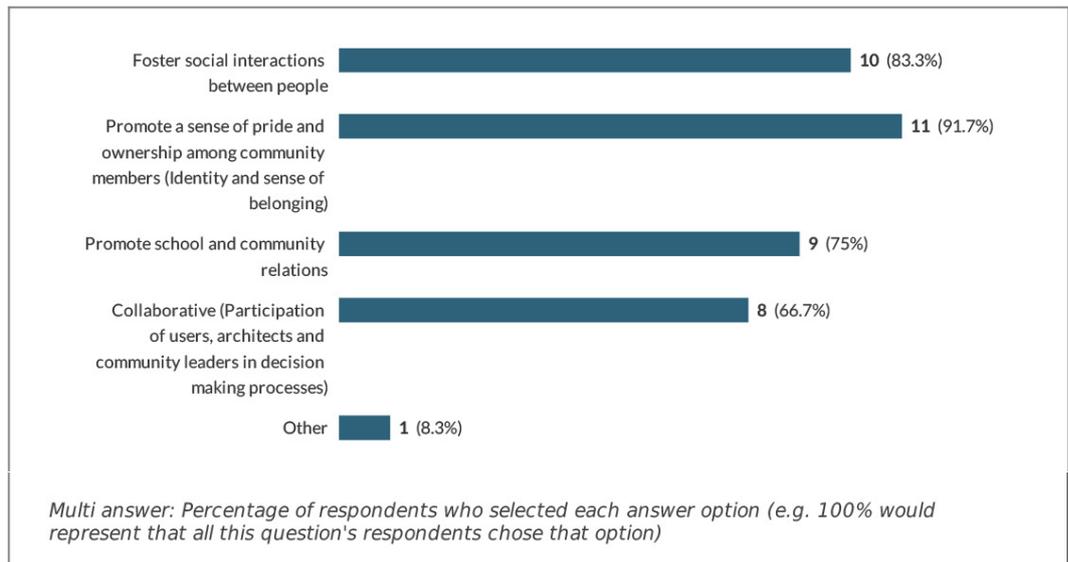
16 Access & Linkages: What sources of “placemaking” informed the school design? (Please select all that apply)



16.a If you selected Other, please specify:

Showing all 3 responses	
The openness of the entrance design is inviting to all visitors. Integration between interior and exterior areas is an overarching theme throughout the design that starts at the entrance.	572027-572018-56586413
Enclosed patio	572027-572018-57089714
Unfortunately this school is somewhat removed from the urban fabric but the decision to make it an agricultural vocational school goes well with the semi-rural context of the site.	572027-572018-57090573

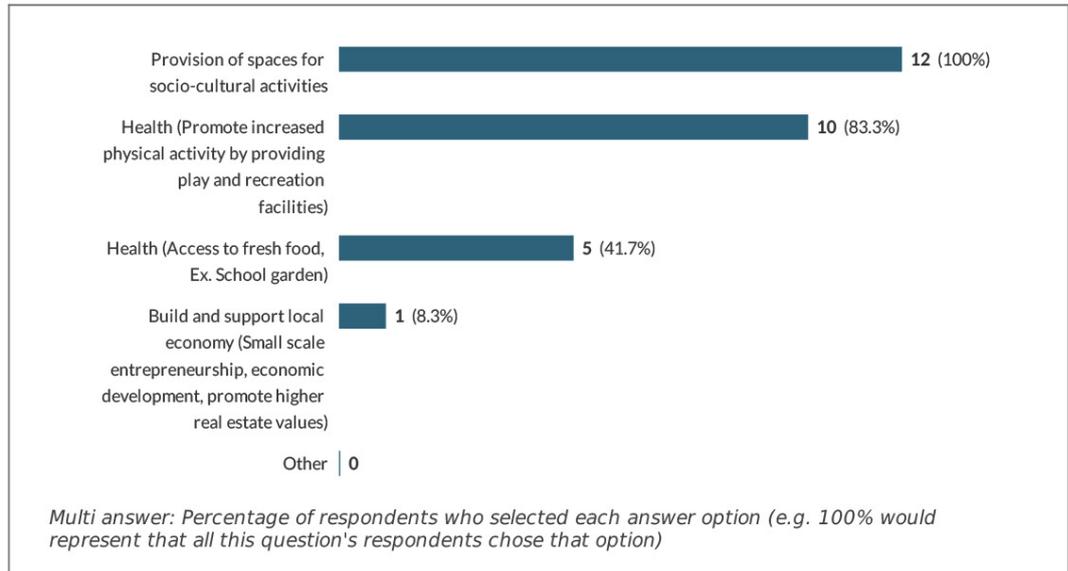
17 Sociability and Participation: What sources of “placemaking” informed the school design? (Please select all that apply)



17.a If you selected Other, please specify:

Showing 1 response	
Connection to Boys and Girls club	572027-572018-57088783

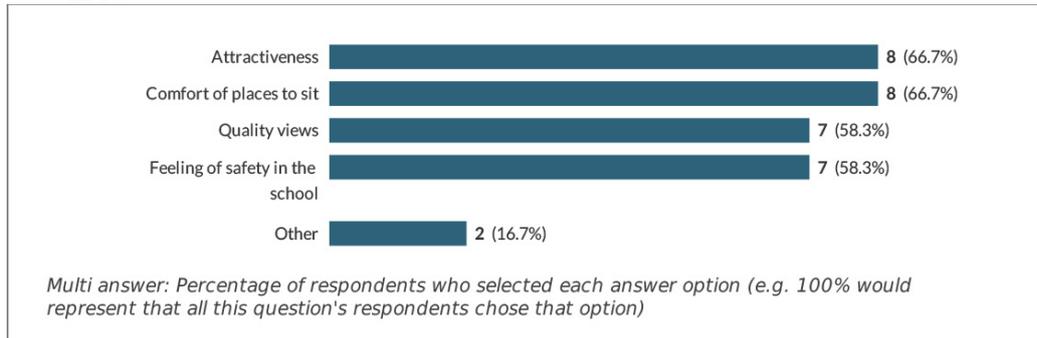
18 Uses and activities: What sources of “placemaking” informed the school design? (Please select all that apply)



18.a If you selected Other, please specify:

No responses

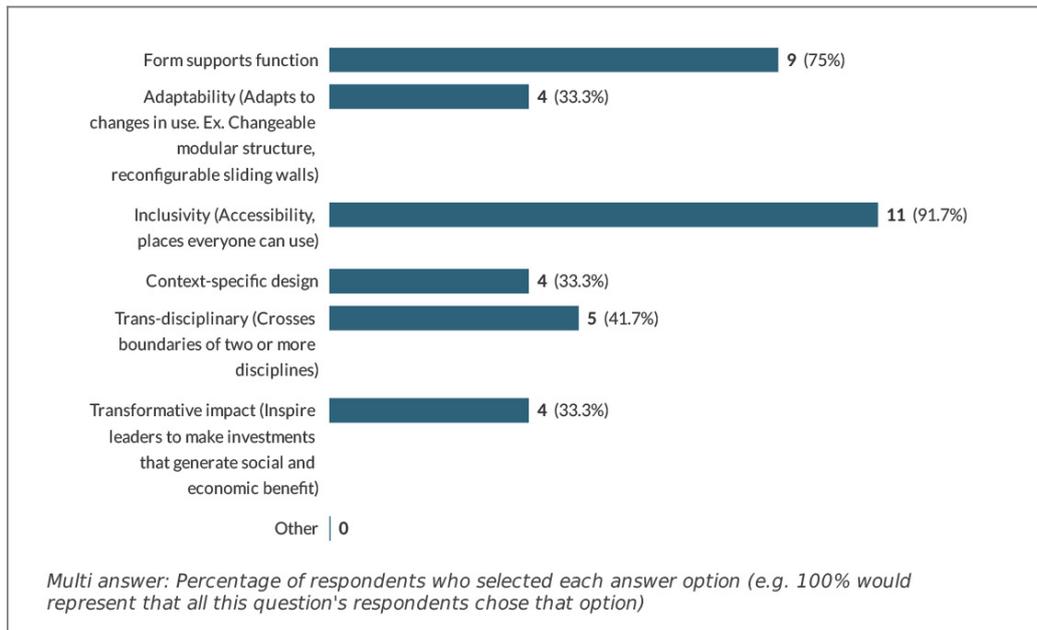
19 Comfort and image: What sources of “placemaking” informed the school design? (Please select all that apply)



19.a If you selected Other, please specify:

Showing all 2 responses	
Integration between interior and exterior areas is an overarching theme throughout the design.	572027-572018-56586413
Abstract references to early 20th century schools in Puerto Rico and use of color related to children's modeling clay	572027-572018-57089714

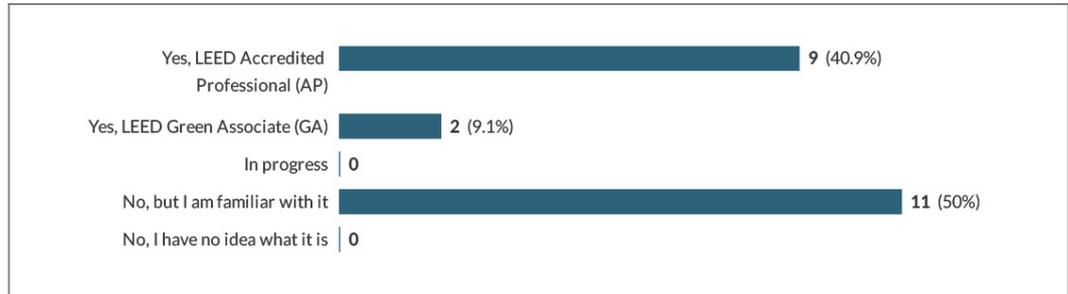
20 Design: What sources of “placemaking” informed the school design? (Please select all that apply)



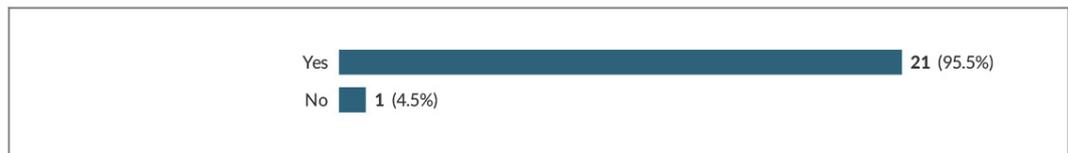
20.a If you selected Other, please specify:

No responses

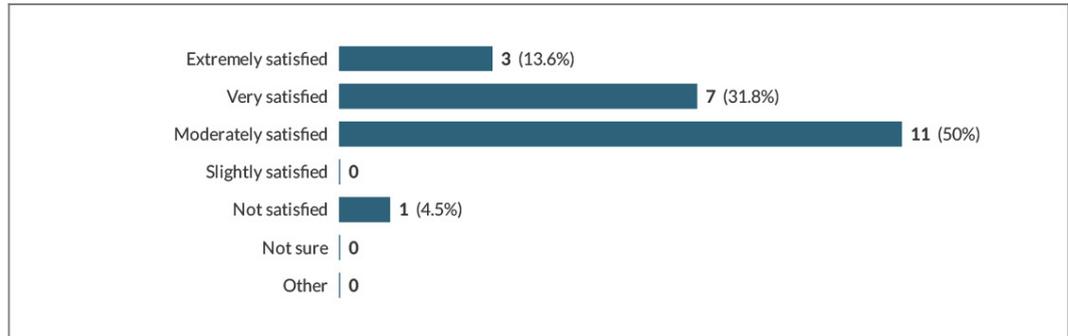
21 Are you a Leadership in Energy and Environmental Design (LEED) Professional?



22 Were you involved in the Leadership in Energy and Environmental Design (LEED) accreditation process in your school?



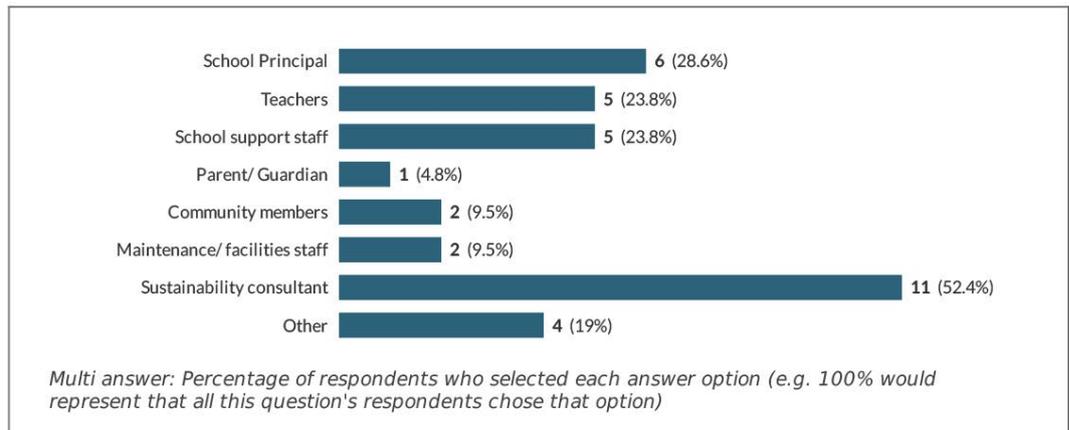
23 Level of satisfaction with the Leadership in Energy and Environmental Design (LEED) Accreditation process in your school? (Please comment in the blank below)



23.a Please comment:

Showing all 9 responses	
Too much information that has to filled manually before uploading.	572027-572018-56330004
The process is extremely boreoarctic and inflexible with the hot and humid climate's realities.	572027-572018-56407621
LEED was a requirement but it felt as if the direct client (Department of Education) didn't understood well the potential of the program.	572027-572018-56645211
LEED requirements (back then) forced us to discard natural ventilation in classrooms as an option, which is sad...	572027-572018-56998991
The System is more attuned to Commercial and Office Buildings rather than Schools	572027-572018-57089206
Because of tight budget and the delivery method used for 21st Century Schools (Design Built) several compromises in the desired sustainability goals had to be made.	572027-572018-57090573
Although the process is cumbersome, to say the least, the results are worth it.	572027-572018-57091125
I have reservations in the process of commissioning. I rather spend the money in sustainable construction than in bureaucracy.	572027-572018-57091513
I were able to achieve a higher certification than what was proposed and required within the same budget. In addition, all sustainable measures taken were to be used as a tool in the vocational curriculum of the school.	572027-572018-57091844

24 In addition to the project team, who else was involved in the design and planning process of your sustainable school? (Please select all that apply)



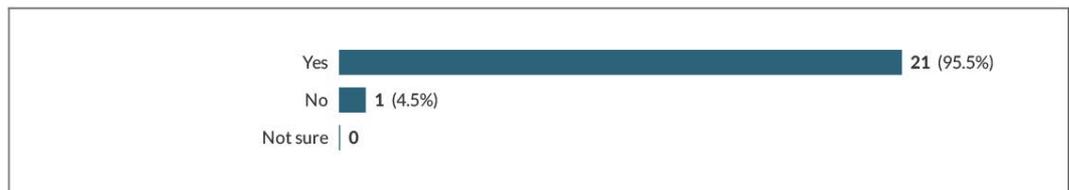
24.a If you selected Other, please specify:

Showing all 4 responses	
Project management owner representative	572027-572018-56451111
The Department of Education and the Project Management Company.	572027-572018-56645211
Don't know, the architect coordinated all the work and we only provided support	572027-572018-56733331
By "school support staff" we mean the Department of Education vocational programs specialist who developed the architectural program.	572027-572018-57090573

25 Do you think LEED targets the following sustainability dimensions?

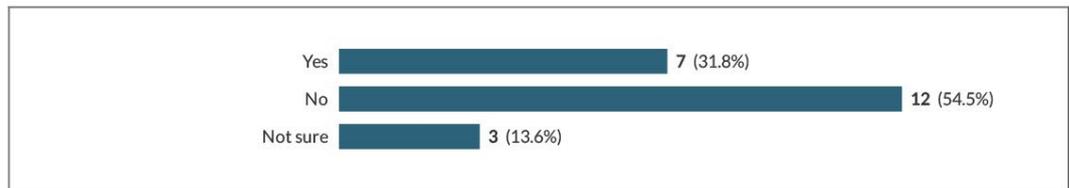
25.1 Environmental

25.1.a Environmental



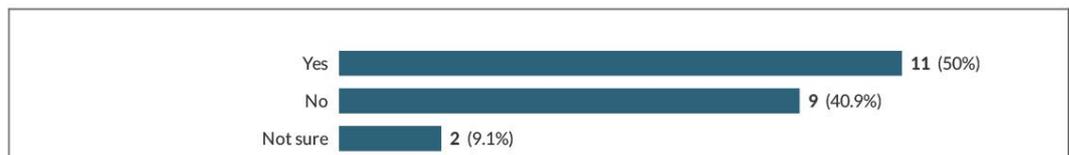
25.2 Economic

25.2.a Economic



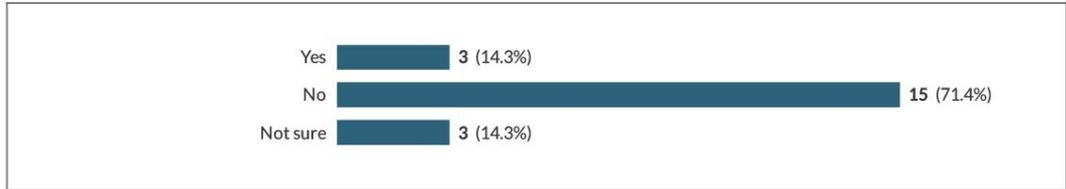
25.3 Social

25.3.a Social

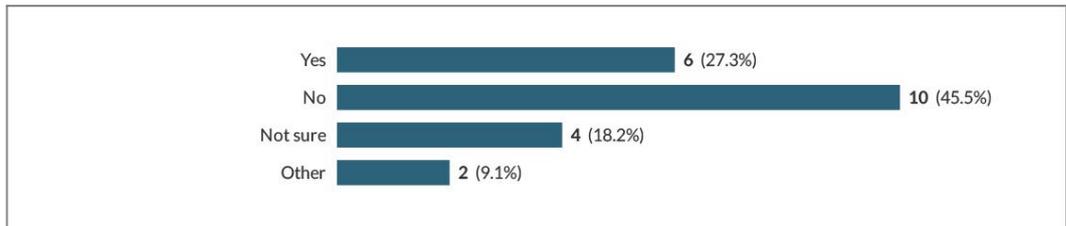


25.4 Cultural

25.4.a Cultural



26 Do you think LEED is an adequate tool for measuring sustainability in Puerto Rico? (Please explain in the blank below)



26.a Please explain in the blank below.

Showing all 20 responses	
LEED Accreditation is expensive and labor intensive. Not all projects have the capability to comply with all aspects of the process even though these may be designed with good engineering and architectural practices that meet or exceed what would be required for certification.	572027-572018-56167650
Problem is related to the government's ability to know about this issue.	572027-572018-56223051
People need to talk about sustainability not LEED. The problem is that this type of certification promotes itself not sustainability.	572027-572018-56230509
LEED refer to ASHRAE 90.1, and 90.1 does not addresses tropical climate. The caribbean is not the same as Florida.	572027-572018-56330004
Many items developed for typical construction in the US and they don't consider conditions in PR adequately.	572027-572018-56373962
LEED basically focuses on energy reduction by using equipment with good efficiency performance and upgrading the building's envelope characteristics. That does not necessarily imply the use of less energy.	572027-572018-56407621
does not take into consideration passive tropical design.	572027-572018-56451111

It's a global framework.	572027-572018-56541869
<p>The LEED process inherently (through ASHRAE/IESNA) adapts to different climates and it also provides a section for Innovation and Design. Nonetheless, there are some culturally different scenarios where LEED falls short to incentivize. For example, in Puerto Rico most of the year, in a well design building with passive bioclimatic strategies implemented, living in unconditioned spaces is possible and even preferable. People in PR are familiar to live with their windows opened when climate permits. The Jose de Diego Ecological School is one of those buildings where shade and natural ventilation is correctly applied. An energy modeling does not represent the value of having unconditioned habitable spaces because they are modeled as the same in the Baseline as well as in the Design Case as per Appendix G of ASHRAE/IESNA 90.1. It will be interesting to research if there is an approved Innovation in Design Credit that values the implementation of passive design strategies and how do they quantify their contribution in energy efficiency achieved by habitable unconditioned spaces.</p> <p>In addition, community participatory methods are included in LEED for Neighborhoods, but it should also be included more strongly in the requirements of the LEED v4. Integrated Design Credit or other. PR is currently in a constant state of emergency since María Hurricane and now the Earthquakes. Community participation in the reconstruction process of the disasters is fundamental more than ever.</p>	572027-572018-56586413
It is specially useful for commercial and institutional buildings, not so much for residential.	572027-572018-56645806
<p>Puerto Rico for many reasons is different from other states. Island conditions, political, economic conditions, idiosyncrasy, bureaucratic, culture, tradition, among others, makes the compliance with LEED credits a challenge and daring task. I don't really know if I can say that LEED is not an adequate tool for measuring sustainability in Puerto Rico. However, below some of the greater challenges found during the credential process:</p> <p>Despite the rising acceptance in concepts of sustainable building in PR, it's been a large challenge trying to encourage construction teams to implement green building concepts and practices such as energy savings, environmentally friendly waste management practices, the use of high-performance technologies, and the use of low environmental impact materials, among others.</p> <p>One of our first challenges was getting the Design/Build team to think differently about how the LEED project team works together and how the LEED building project is managed. The members of the team were used to work the old fashion way, they got involved with one another on an "as-needed" basis. In order to have a successful LEED Certified school it was essential to create an integrated design approach from day-one of the projects.</p> <p>Establishing the simulation methodology to be used for compliance with the Minimum Energy Performance was a daring task. Being a tropical island, Puerto Rico's climate has always provided a perfect setting for naturally ventilated spaces. Moreover, cross-ventilation is an essential factor in space design and ceiling fans are usually provided to enhance ventilation. making the majority of the spaces unconditioned spaces.</p>	572027-572018-56649526

particularly in schools all over the island, but at the same time regularly occupied. Even though the USGBC suggests that projects with natural ventilation use the Exceptional Calculation Methodology, this states that a hybrid system should be modeled in which “[...] a cooling system is provided by natural ventilation when conditions are acceptable and by the default mechanical cooling system when natural ventilation is inadequate to provide thermal comfort.” However, Puerto Rico’s tropical climate will never fall under these conditions since they are always adequate for natural ventilation if the space is properly designed, and a supplementary “default mechanical cooling system” will not be necessary, hence never provided in unconditioned spaces.

From the beginning of the project’s planning process, it was decided to use the Whole Building Energy Simulation Methodology where the building performance rating method is to be established as per ANSI/ASHRAE/IESNA Standard 90.1-2007 Appendix G. The latter states that the simulation model of the proposed design shall be consistent with the design documents, and that all conditioned spaces in the proposed design shall be simulated as being both heated and cooled even if no heating or cooling system is to be installed. ANSI/ASHRAE/IESNA Standard 90.1-2007 defines conditioned space as “a cooled space, heated space, or indirectly conditioned space” and unconditioned space as “an enclosed space within a building that is not a conditioned space or a semi-heated space”. This being said, naturally ventilated spaces fall under the unconditioned space category, therefore would not need to be modeled with any cooling system unless it conforms to the conditions specified in the Exceptional Calculation Methodology.

Even though the ANSI/ASHRAE/IESNA Standard 90.1-2007 has been followed for energy modeling simulation, it has been a challenge to model naturally ventilated spaces in tropical climates because the provided standards are created for other types of climates. Furthermore, traditional construction methods are based mainly on masonry walls and reinforced concrete for any type of space, mainly because they have always been available local materials used for the building envelope. When air conditioning started being used in the island for specific type of spaces, envelope considerations did not change as the general conception on envelope was that insulation is only needed in cold climates for heating purposes. For this reason, it has been very difficult make the contractors and the team to understand the importance of the envelope’s R-value and why it is essential to invest the money in those items. Nevertheless, through several long meetings and constant team interaction, energy model results revealed the importance of envelope considerations.

It definitively is the best tool available right now to measure sustainable buildings. I recognise is not tailored to integrate social or cultural aspects as it is up to the designer to integrate this into the sustainable efforts already in the system.

[572027-572018-56645211](#)

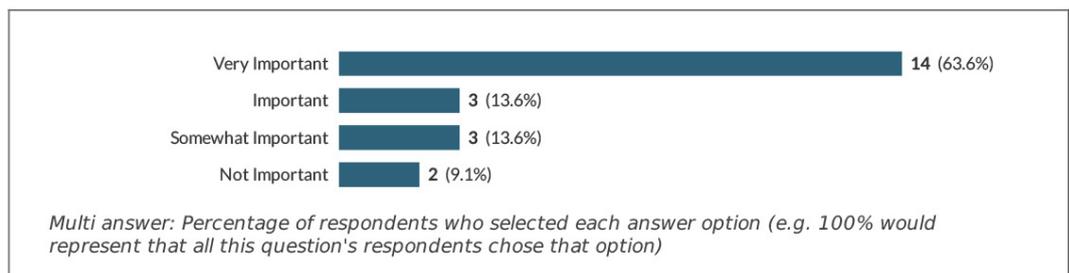
Energy and water consumption studies and validation data should support design approaches. The industry and the building code(specially the energy conservation code) already addresses on building envelope, equipment performance, etc. which already makes the construction more expensive, If you want to pursue more points for a higher accreditation you have to spend more money. I think that together with the energy modeling, the validation process during operation must be presented as case studies. Probably it has been done and have excellent outcome. The points for bicycle stands in PR are ok, but in reality the weather her does

[572027-572018-56733331](#)

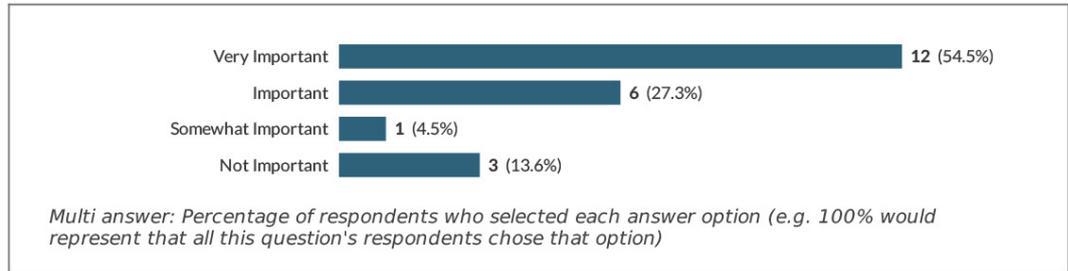
no invite to use it as a means of transportation.	
Natural ventilation of spaces is essential in tropical architecture. LEED (ASHRAE 62.1) dis-incentivizes natural ventilation and is a pre-requisite to attain LEED certification...	572027-572018-56998991
The strategies are adequate, but the long term maintenance needs to be part of the process. For this particular project, the people involved in the LEED certification were not part of the school staff after the certification was granted. Teachers reach out to me for complicated maintenance problems 5 years after the school was finished for something they could easily solve with maintenance.	572027-572018-57088783
Does not take into account our Tropical Climate, and Spanish/Taino/African Cultural Heritage.	572027-572018-57089206
There is always the issue of continued operational and maintenance of the facility that not always (sometimes never) are not used and maintained as the sustainable design intended.	572027-572018-57090573
There is resistance among project owners about the upfront cost of designing and implementing the LEED guidelines.	572027-572018-57091125
LEED is a great guide to aid in sustainable construction, but the costs not related to physical work should be addressed so that more physical work can be performed.	572027-572018-57091513
I believe it covers the basics in many aspects wherever the project may be located, and in addition allows for a more local approach if Innovation in Design credits are used for something that targets local and cultural aspects. However, I think there are many areas of improvement and these tools to integrate the regional aspects of a project don't have enough value/weight as they should. Nonetheless, I still think it is adequate as a starting point and to handle environmental issues that otherwise here in PR, construction projects don't address because they are not "required" to do so and might cost more. Today, many designers do manage the improvement on water and energy consumption and include efficiency in their designs, which gets a lot of the points assigned in the LEED certification system, but during the construction process, sustainability issues related to materials, indoor air quality, site, waste management, and others are not necessarily addressed unless a LEED certification is pursued.	572027-572018-57091844

27 Cultural Communication/ Economy: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

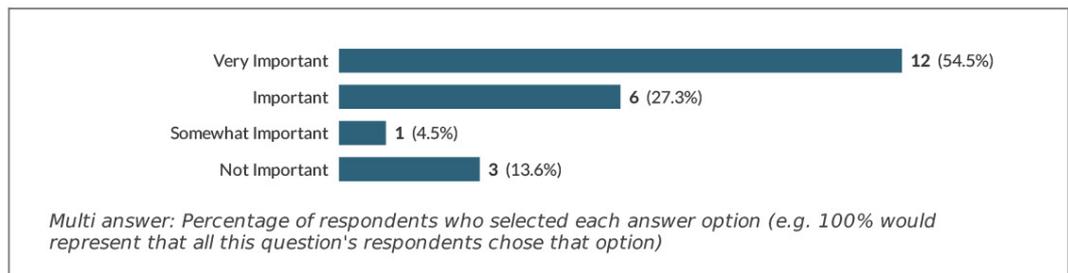
27.1 Access to the internet, particularly for cultural and creative content.



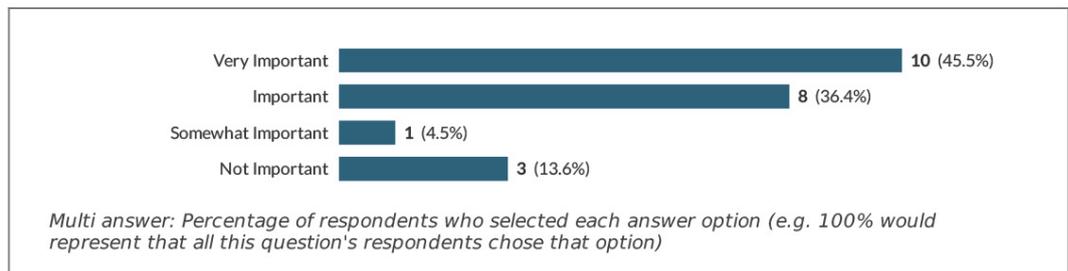
27.2 Freedom of expression: Ability for all individuals to enjoy the right and opportunity to speak, write, and create, among others.



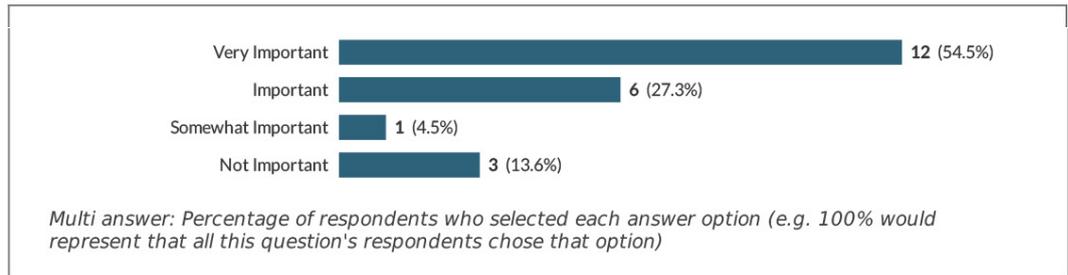
27.3 Public expenditure, at the Dept. of Education of P.R. and/or School level, in support of arts and cultural activities.



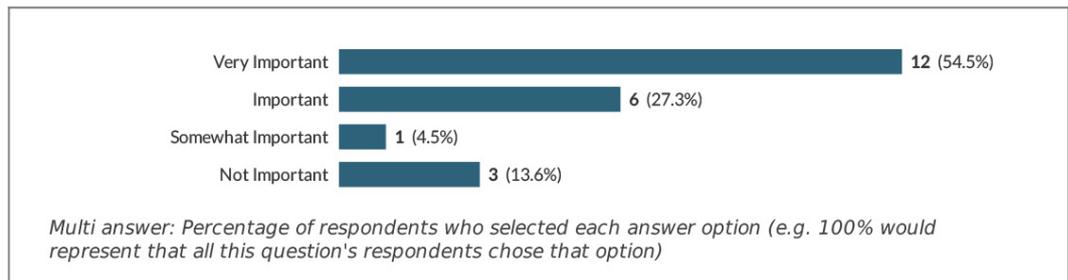
27.4 Amount of money spent by school community members on cultural activities, goods and services



27.5 Philanthropic expenditures in support of arts and culture (Ex. charitable giving to cultural entities).

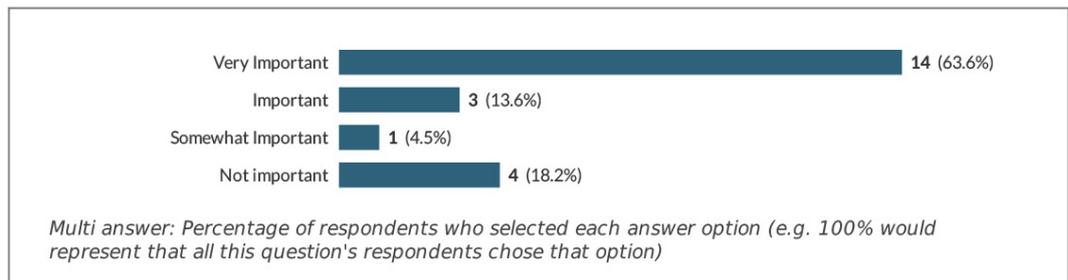


27.6 Academic Integrity: Raise awareness on plagiarism, academic ethics and scholarly values.

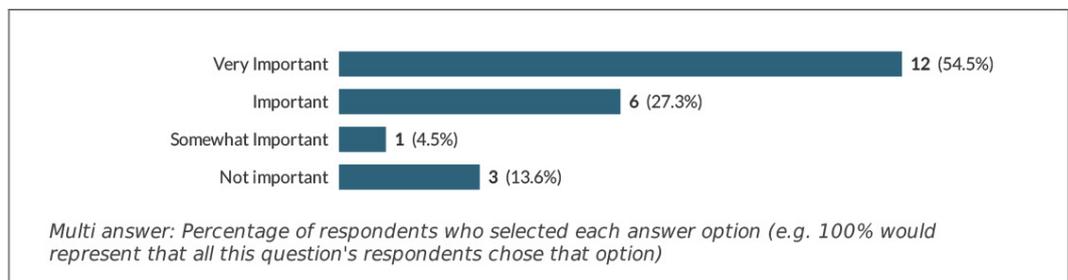


28 Cultural Education/ Governance: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

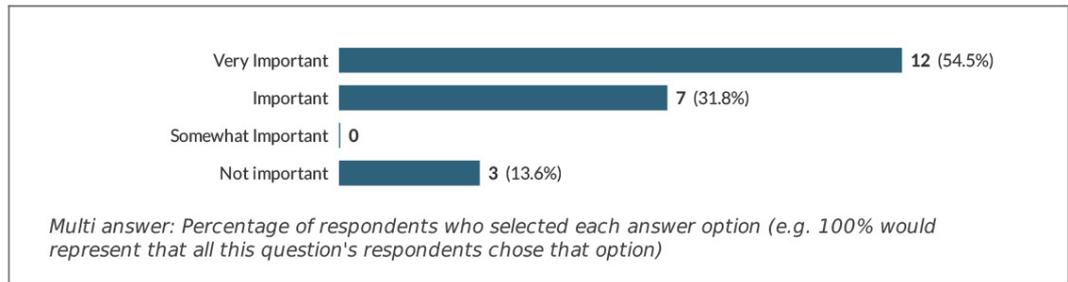
28.1 Multilingual Education (teaching of two or more languages)



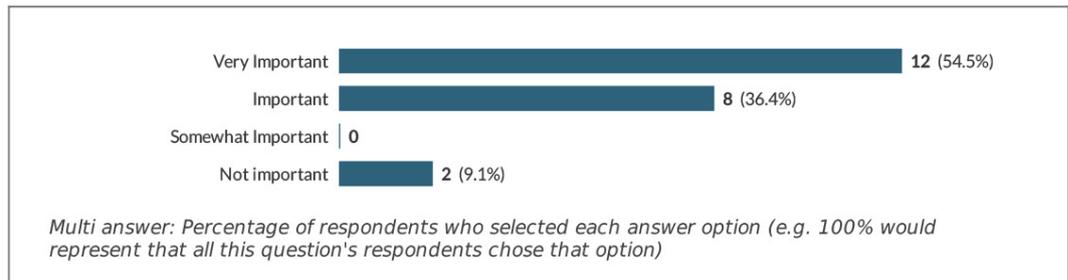
28.2 Professional Training in cultural and creative fields (Ex. design, music, arts and cultural management, among others).



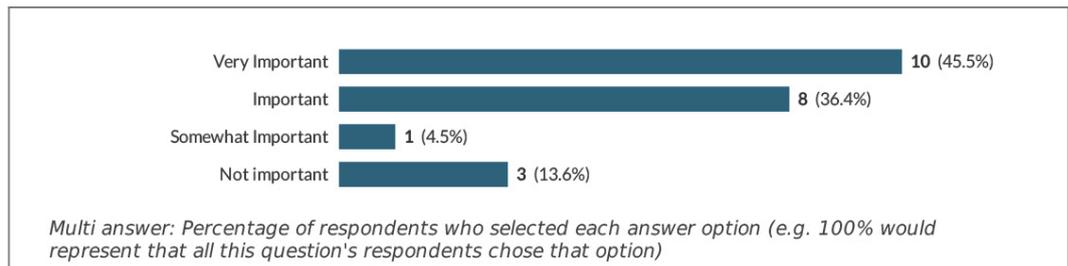
28.3 Arts Education is included in the curriculum.



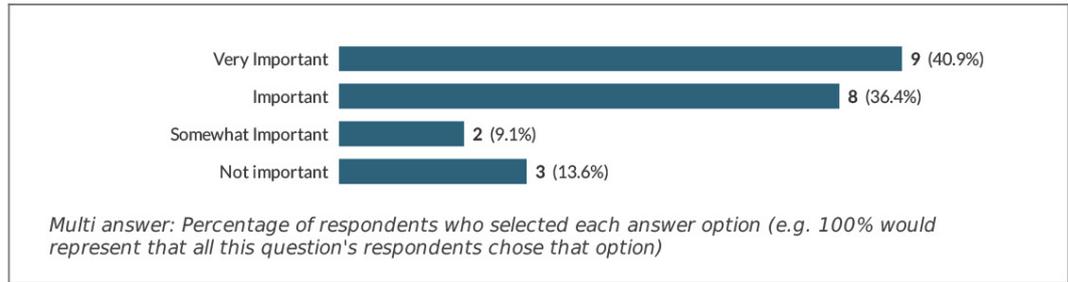
28.4 Child involvement in afterschool arts and cultural programs



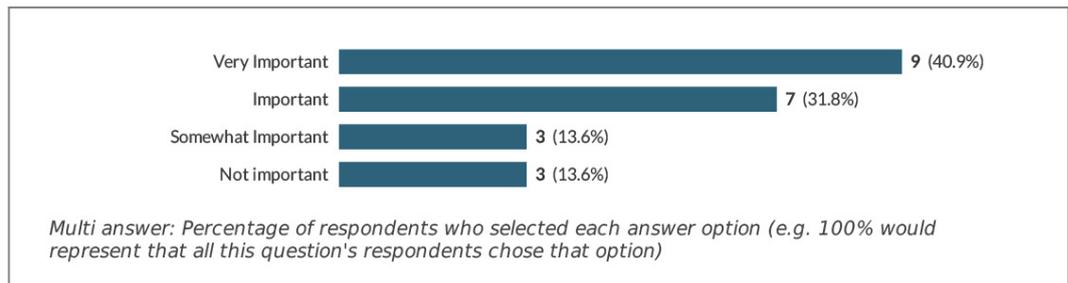
28.5 Explicit public policies about arts and culture



28.6 Participation of school members in cultural governance (Ex.: formulation and implementation of cultural policies and programs)

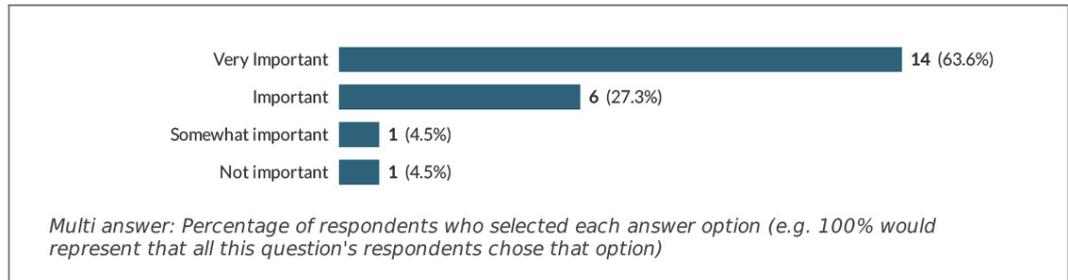


28.7 Administer a Post-Occupancy Cultural Evaluation to school members to inquire about cultural communication, education, governance, economy, participation, heritage, spaces and events.

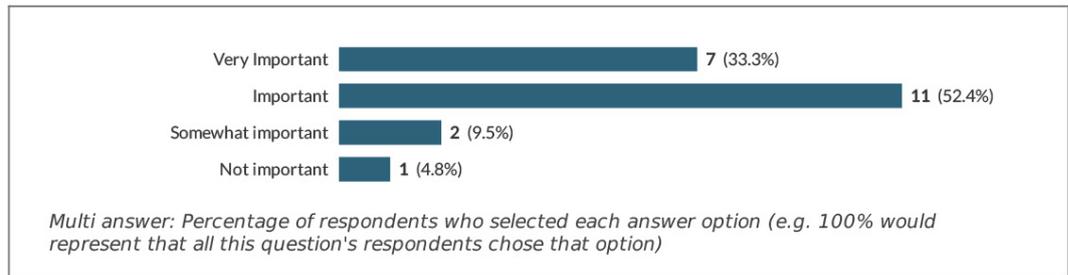


29 Cultural Heritage: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

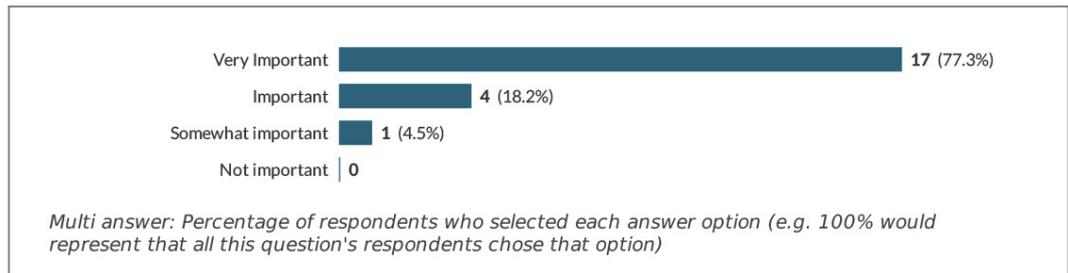
29.1 Impact of the school design on existing streetscapes.



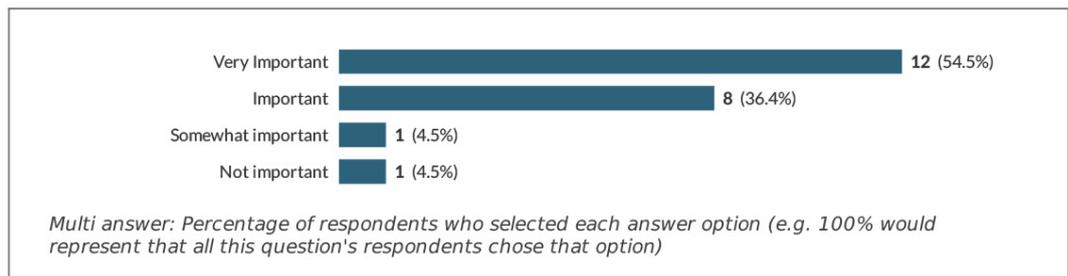
29.2 The building reflects collective memories and protects the local history and character of a place.



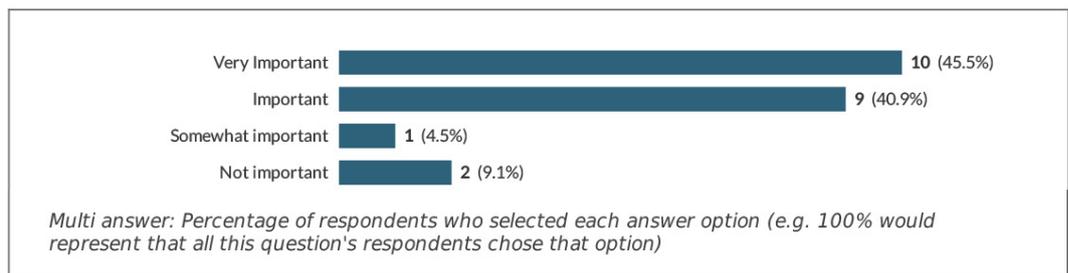
29.3 Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.



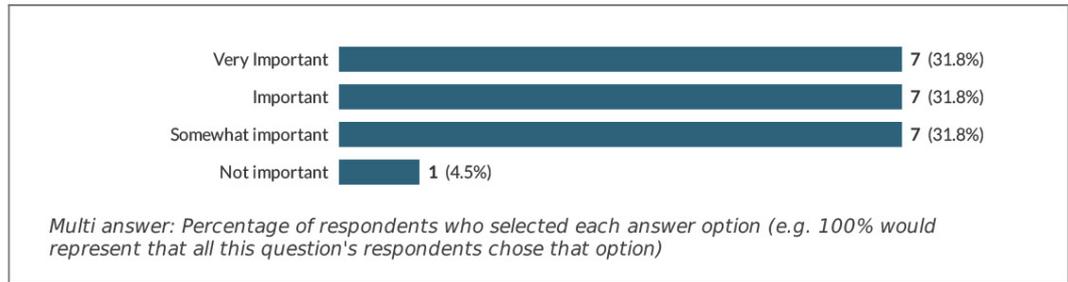
29.4 Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.



29.5 Respecting socio- cultural identity and context: Projects should help to enhance local culture, habits and traditions, while accepting that it may sometimes be appropriate to work to help to change the culture of any given locality.

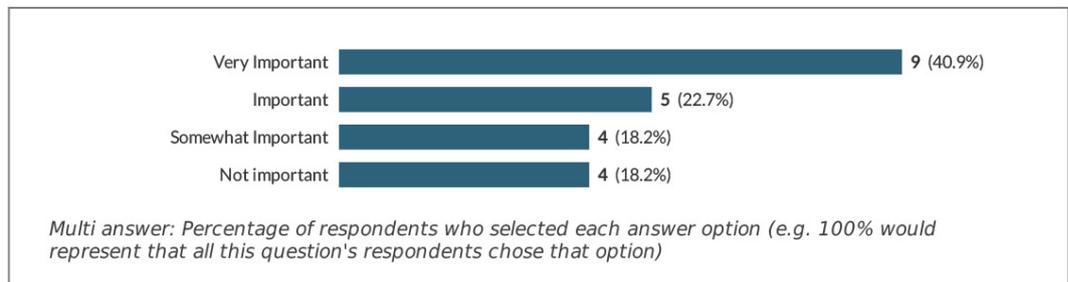


29.6 The building involves traditional materials, craftsmanship and techniques

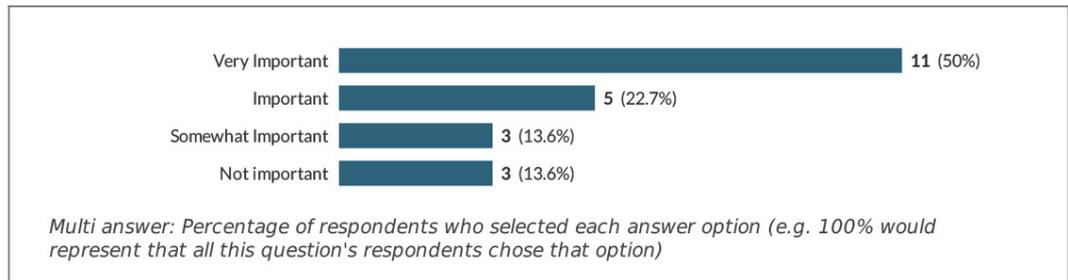


30 Cultural Inclusion and Participation: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

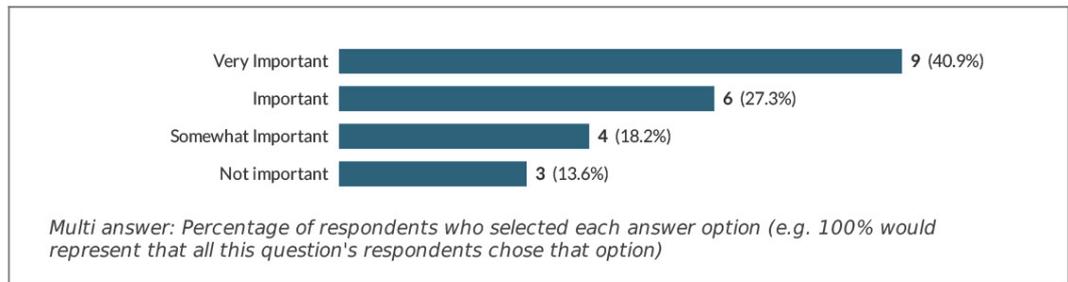
30.1 Collective art- making practices and purchase of artistic materials



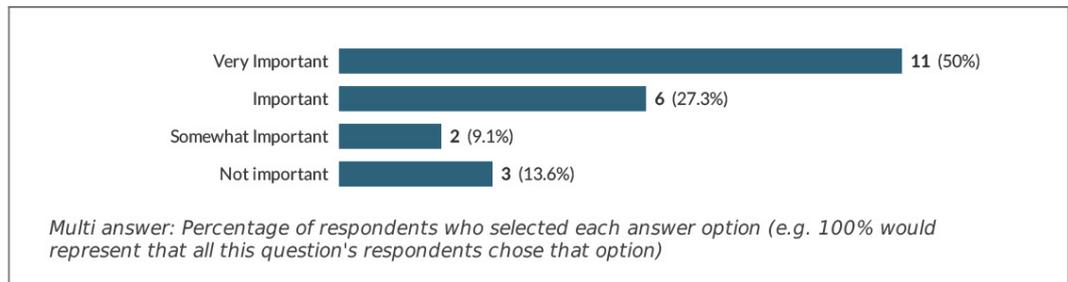
30.2 Volunteering and personal support of arts and cultural activity



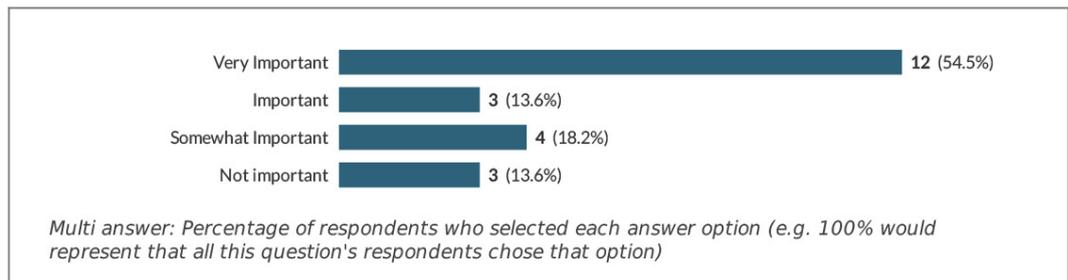
30.3 Enrollment in arts training programs and membership in arts associations



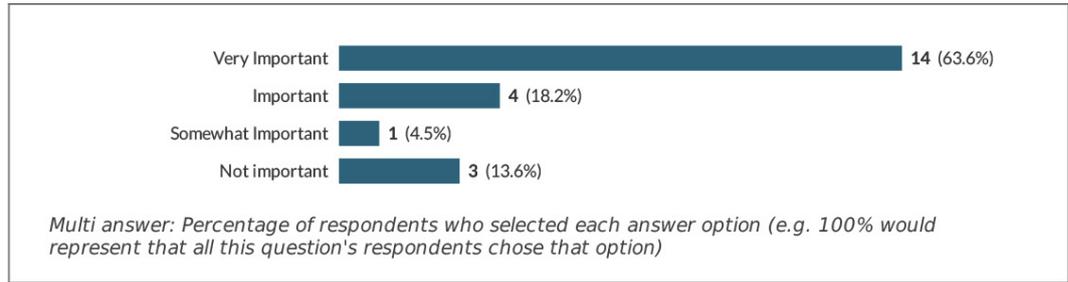
30.4 Participation in cultural activities (Ex: cinema, theatre, concerts museum, historical/cultural park and festivals, among others.)



30.5 Freedom of self- determination: evaluates individuals' sense of empowerment to decide and live the life they choose.

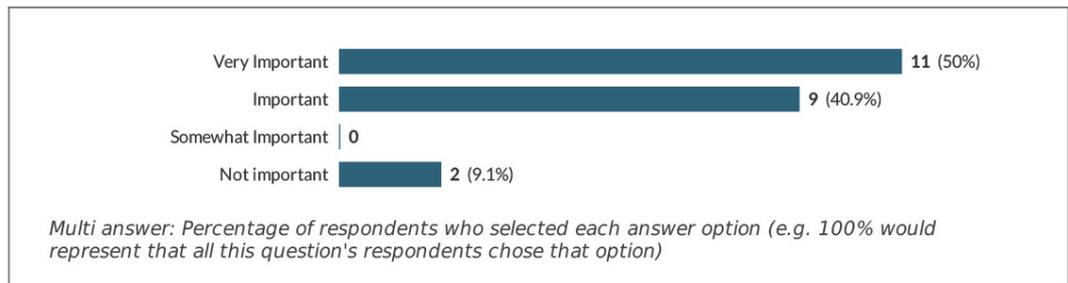


30.6 Gender equality: Provision and perception of equal opportunities and rights between women and men in terms of education and labor force participation.

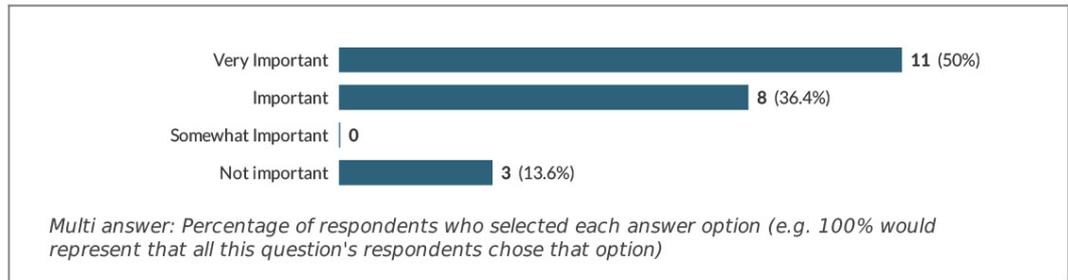


31 Cultural Spaces and Events: Please rate how important it is for you that LEED includes the following cultural indicators to assess sustainable schools in Puerto Rico:

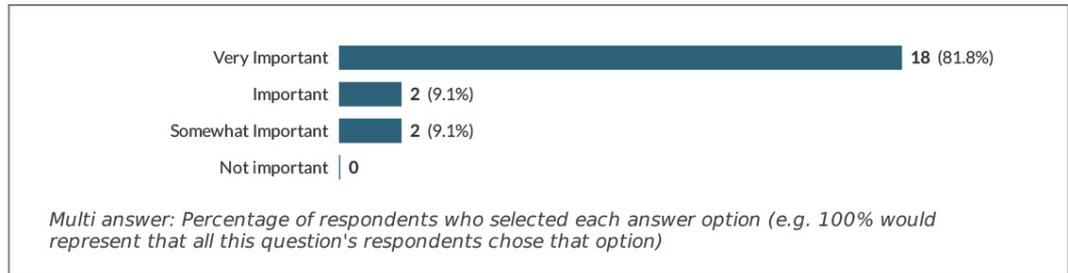
31.1 Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.



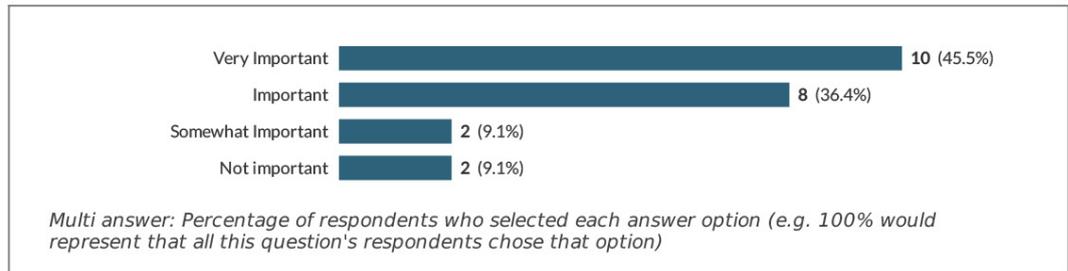
31.2 Availability of short- term and episodic cultural venues and events (Ex. festivals, arts and craft markets).



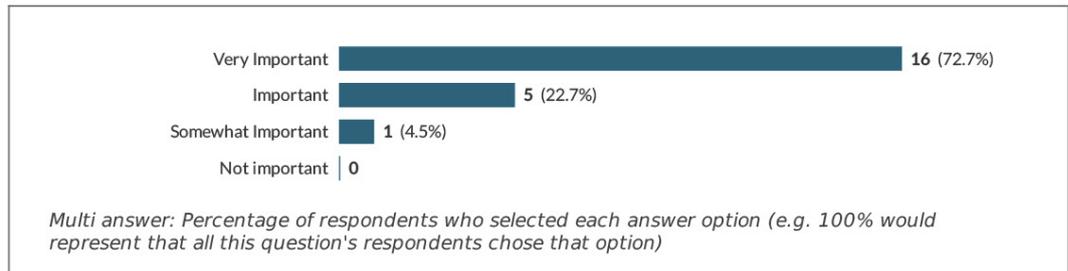
31.3 The building has spaces for cultural activities.



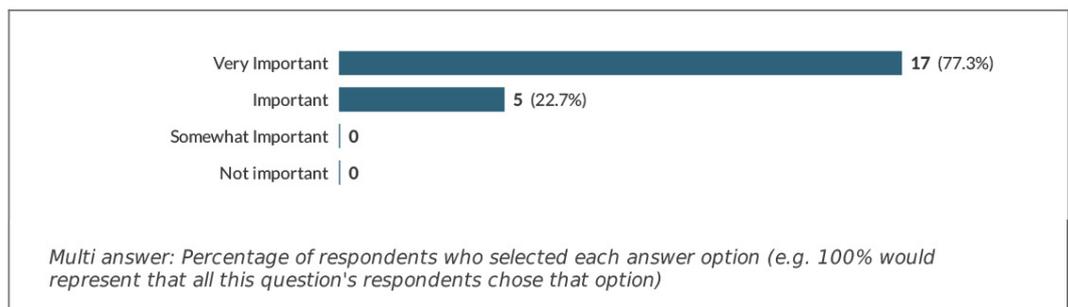
31.4 Provide a space for communal meals.



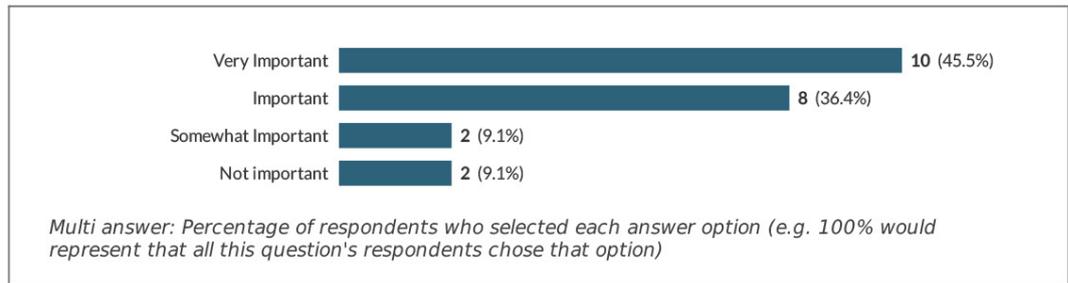
31.5 Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.



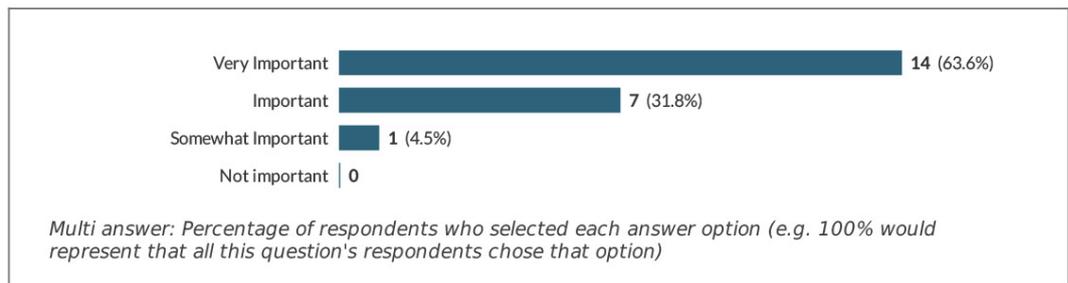
31.6 Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.



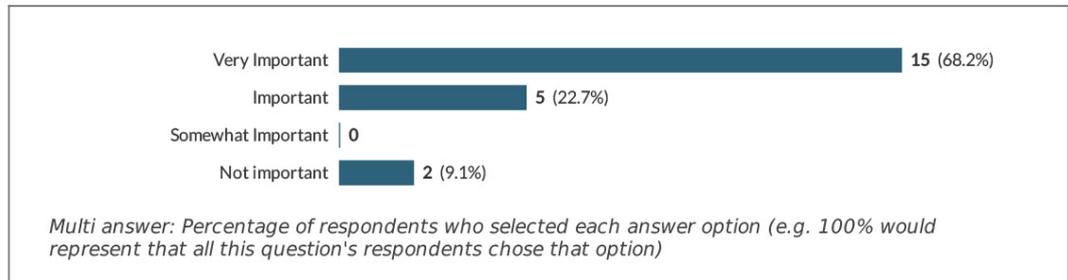
31.7 Integrate public art and local artists in the school (Ex. exhibits).



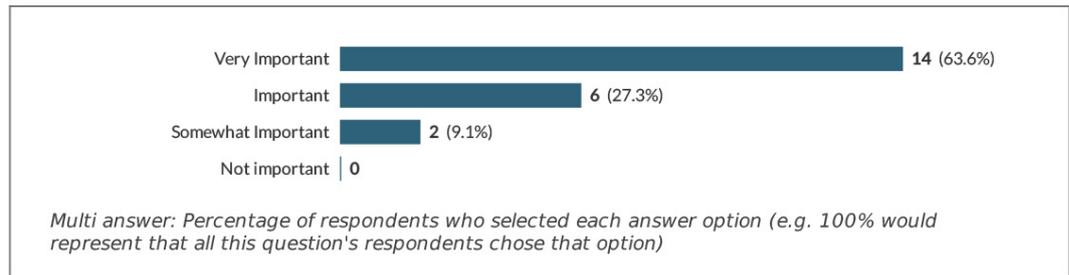
31.8 Biophilic Environment: How the project will be uniquely connected to the place, climate and culture through Place- Based Relationships: Provision of human- nature interactions in both the interior and exterior of the project.



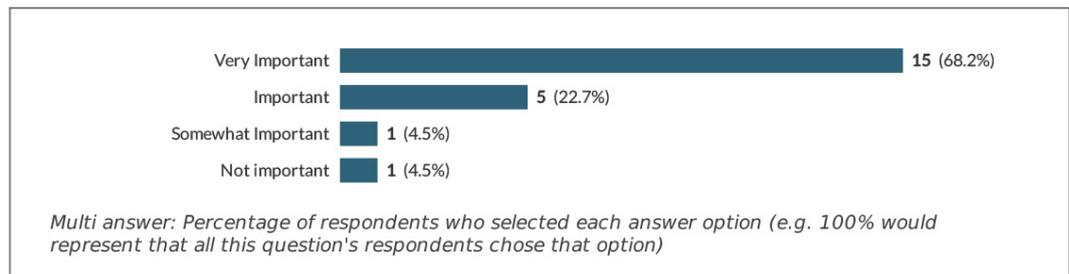
31.9 The building makes people feel a sense of place, belongingness and rootedness.



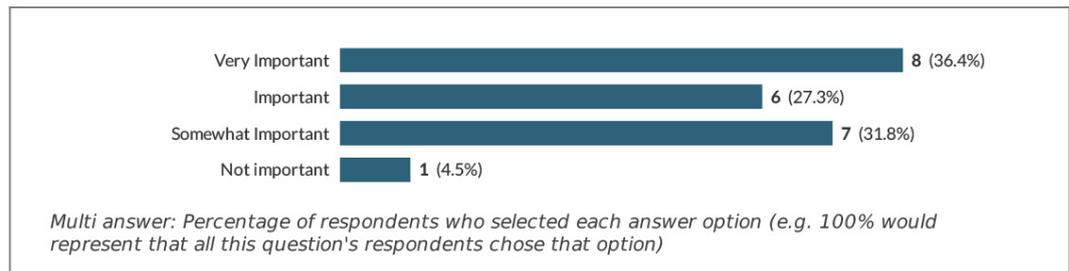
31.10 The building is designed with adaptability (Where possible, buildings allow further development and allow internal spaces and layouts to be modified).



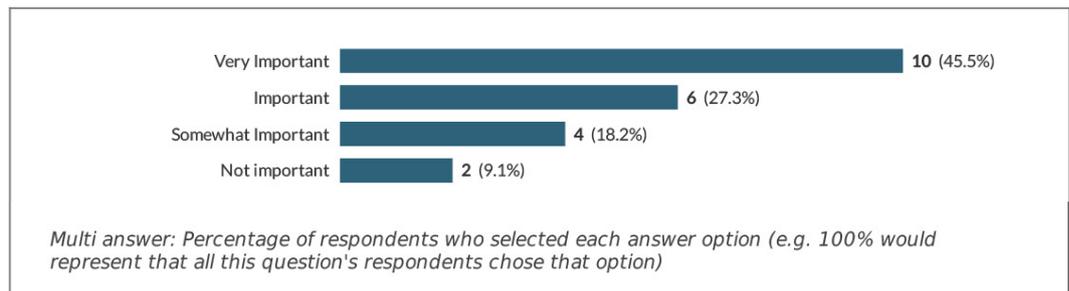
31.11 Learning environments and school culture foster creativity and innovation.



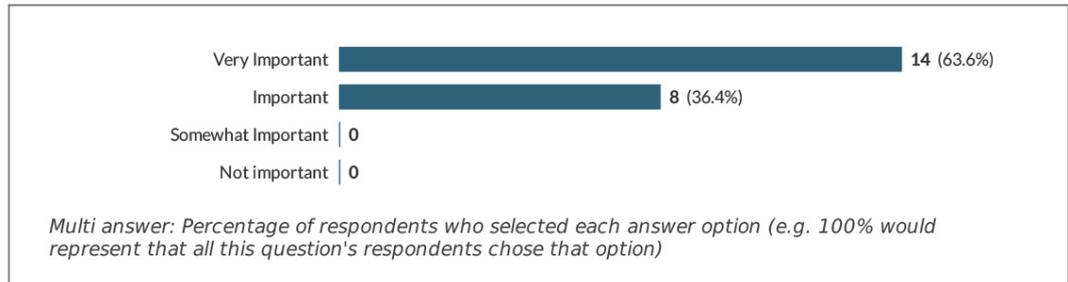
31.12 Spiritual enrichment: The building (and/or its surrounding site) encourages the inner development and spirituality of humans (Ex. meditation spaces and programs)



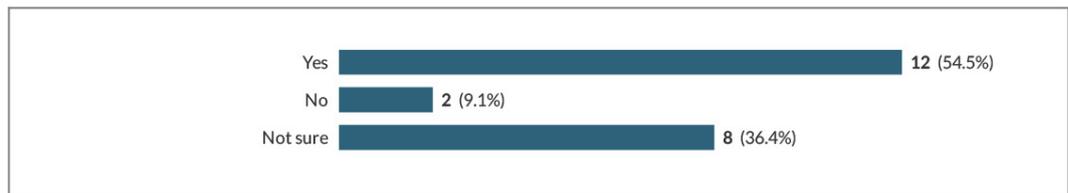
31.13 Aesthetic quality of the building



31.14 Neighborhood Facilities: Availability and access to cultural related establishments, venues or organizations.



32 Would you be inclined to have a follow-up interview?



33 Email address

APPENDIX L: SEMI-STRUCTURED INTERVIEW QUESTIONS (PHASE 3)

CONSENT FORM



INTERVIEW

Research Project: (Re) Measuring (LEED) Sustainability: From a Global Rating System to Tropical Specificity

Description

You are invited to participate in the research project titled *[Re] Measuring [LEED] Sustainability*, which I am developing, as part of my doctoral studies at Nottingham Trent University (NTU) in the United Kingdom. The aim of this study is to identify socio-cultural factors in Puerto Rico (P.R.) that could be incorporated as indicators in the Leadership in Energy and Environmental Design (LEED) green building certification system for the particular case of schools, in order to adequately adapt this system to the tropical context.

We are asking you to participate in this research, because you were an architect, engineer or sustainability consultant in one of the eight (8) LEED certified schools that were part of the Schools for the 21st Century Program in the Island.

Your participation will consist of an interview lasting approximately 45 minutes. There are several questions we would like to discuss with you about culture and the LEED certification process of the school you worked on. However, you only need to respond to the ones you want to. There is no time limit on this interview it may be as long or as short as you wish. All interviews may be recorded and transcribed into text form with identifying features removed (e.g. names and places). Relevant quotations may then be included in the final report. All recordings will be stored securely and remain confidential.

Risks and benefits

Your participation does not involve any risks other than what you would encounter in daily life. If you are uncomfortable with any of the questions or topics, you are free not to answer. You will not receive any direct benefit, beyond the satisfaction of having contributed to the improvement of the assessment tool for sustainable buildings in Puerto Rico.

Confidentiality

Personal information or data that can identify you directly or indirectly will be handled confidentially. Unless required by law, only the study investigator and NTU supervisory team have the authority to review your records.

Results of this study may be used for teaching, research, publications and presentations at professional meetings. If your individual results are discussed, then a code number will be used to protect your identity. Anonymized data may be used in other studies in line with the University Research Data Management Policy.

NTU is committed to respecting the ethical codes of conduct of the United Kingdom Research Councils (RCUK) and the European Union *General Data Protection Regulation* (EU GDPR). Thus, in accordance with established procedures, the University will conserve all information and data collected during the research in line with University Policy, consistent with both RCUK, and the EU GDPR (<https://www.ukri.org/about-us/policies-and-standards/gdpr-and-research-an-overview-for-researchers/>).

Data will be kept confidential and in a secure place for 6 years, after the research is finished, in line with the Research Data Management Policy and destroyed in line with the current RCUK/University/GDPR Guidelines.

Rights

If you read this document and decided to participate, please understand that your participation is voluntary and that you have the right to refrain from participating or withdraw from the study, without penalty. If you wish to withdraw your consent please contact me before March 15, 2020. In addition, you have the right to receive a copy of this document.

If you have any questions or would like more information about this investigation, please contact Arch. Eileen L. Díaz (eidilart@gmail.com) or the research supervisor Dr. Marisela Mendoza (marisela.mendoza@ntu.ac.uk).

If you want to speak with someone who is not directly involved in this research, or if you have questions about your rights as a research subject, contact Professor Michael White, Chair for the College Research Ethics Committee (CREC) for the College of Art Architecture Design and Humanities (CAADH) at NTU. You can send an e-mail to michael.white@ntu.ac.uk.

Your signature on this document means that you decided to participate in this investigation after reading and discussing the information presented on this consent sheet and that you received a copy of this document.

Participant's Full Name	Signature	Date
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I discussed the content of this consent form with the participant.

Researcher's Full Name	Signature	Date
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Interview Questions

Research sample: Architects involved in the eight (8) LEED certified schools in P.R.

Note: The interview will be performed in spanish or english language depending on the participant's preference.

Questions to verify that participants understand the research protocol (These will be done after discussing the Informed Consent Form and before starting the interview)

Participants will be asked to explain in their own words the following:

1. What is the research about?
2. What is *expected of you* after you accept to participate in this study?
3. What are your rights as a research participant?

Design Intention

1. What architectural concept and sources of inspiration informed the school design?
2. Do you think your school design influences the culture of the building occupants? How? (Please explain)

Cultural Identity

3. In what way is P.R.'s cultural identity expressed in the school design?

Culture and Placemaking

4. In the survey, you mentioned that the following aspects from your culture informed the school design:
(survey responses will be included here)
Please explain your answer.
5. In the survey, you mentioned that the following architectural elements employed in the school design contribute to the expression of Puerto Rican culture:
(survey responses will be included here)

Please explain your answer. Please give concrete examples of how these architectural elements were employed in your school design.

Cultural Identity/ Design intention:

6. In the survey, you mentioned that the following symbols of Puerto Rican culture were incorporated in the school design:
(survey responses will be included here)

How and why did you decide to use these symbols?

7. In the survey, you mentioned that when you see your school, the following words comes to mind:
(survey responses will be included here)

Please explain your answer.

8. In the survey, you mentioned that the following sources of Placemaking informed the school design. Please give concrete examples of how these strategies were employed in your school design.

(survey responses will be included here)

9. Fielding Nair Guidelines: Do you think that the documents and design guidelines provided for the Schools for the 21st century project were adapted and adequate for the local context?

10. What are the conditions that support or hinder the application of the LEED certification system in P.R.?

11. Cultural indicators

In the survey, the following cultural indicators were considered the most important for sustainable schools in P.R. (table with preliminary list of 13 indicators was provided):

- Do you agree with this selection?
- Do you think any additional indicators should be added?
- Do you think any of the indicators should be eliminated?

Note: Other relevant questions may emerge based on the respondents answers to the interview questions.

APPENDIX M: LEED CERTIFIED STATUS VS. AGE GROUP CROSSTABULATION (Q21)

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)
Fisher's Exact Test	8.345			.028
N of Valid Cases	23			

Symmetric Measures			
	Value	Approximate Significance	Exact Sig.
Phi	0.618	0.032	.027
Cramer's V	0.618	0.032	.027
N of Valid Cases	23		

LEED Certified Status vs. Age Group Crosstabulation (Q21)

		Age				Total	
		35-44	45-54	55-64	65+		
Certified	LEED certified	Count	8	2	1	0	11
		Expected Count	4.8	2.4	1.9	1.9	11.0
		% within age	80.0%	40.0%	25.0%	0.0%	47.8%
Not-certified	Not-certified	Count	2	3	3	4	12
		Expected Count	5.2	2.6	2.1	2.1	12.0
		% within age	20.0%	60.0%	75.0%	100.0%	52.2%
Total	Total	Count	10	5	4	4	23
		Expected Count	10.0	5.0	4.0	4.0	23.0
		% within age	100.0%	100.0%	100.0%	100.0%	100.0%

Fisher's Exact Test Results (SPSS): This research explored if there was any association or relationship between age groups (35-44; 45-54; 55-64; 65+) and professional's LEED certification status. The Fishers Exact Test for independence generated an Exact Significance value of 0.028, less than 0.05 (Corder, 2009: 181). This means that there is a significant difference between certification status and age groups because most certified professionals are 35-44 years old. As shown in the table above, an 80% of participants in this age group are certified. We determined the measure of association between the two variables or effect size by calculating the phi coefficient (Corder, 2009: 169). This coefficient generated a value of 0.618, which represents a large association between the different groups, further validating the Fisher's Exact Test results (Cohen 1988).

**APPENDIX N: CULTURAL INDICATORS SORTED BY MEAN
(HIGH TO LOW) (ANALYSIS #2)**

Indicator (Abbreviated)	Mean Rank	Standard Deviation
31.14. Neighborhood Facilities	3.74	0.43
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	3.70	0.55
31.13. Aesthetic quality of the building	3.70	0.57
31.11. Learning environments and school culture foster creativity and innovation.	3.70	0.63
31.9. The building makes people feel a sense of place, belongingness and rootedness.	3.61	0.49
31.3. The building has spaces for cultural activities.	3.57	0.59
31.6. Joint Use of Facilities	3.57	0.80
31.5. Open Space: Create exterior public space	3.52	0.67
29.1. Impact of the school design on existing streetscapes.	3.48	0.80
31.4. Provide a space for communal meals.	3.48	0.91
29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	3.43	0.80
28.4. Child involvement in afterschool arts and cultural programs	3.39	0.90
27.1. Access to the internet	3.35	1.03
30.6. Gender equality	3.35	1.09
31.1. Cultural Diversity	3.30	0.89
28.3. Arts Education is included in the curriculum.	3.30	1.03
27.2. Freedom of expression	3.26	1.07
27.6. Academic Integrity	3.26	1.07
28.2. Professional Training in cultural and creative fields	3.26	1.07
28.1. Multilingual Education	3.26	1.19
29.5. Respecting socio- cultural identity and context	3.22	0.92
31.10. The building is designed with adaptability	3.22	1.02

Mean: Average of response count

Criteria: Mean 3.25 or higher

Reference studies: (Green,1982; Myllyviita, T., et al: 2013).

Conclusions: 20 indicators qualify

APPENDIX O: CULTURAL INDICATORS SORTED BY YES (%)
(ANALYSIS #3)

Proposed Cultural Indicator	Total	YES (%)	NO (%)	Total
31.6. Joint Use of Facilities	23	100%	0%	100%
31.14. Neighborhood Facilities	23	100%	0%	100%
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	23	96%	4%	100%
31.5. Open Space	23	96%	4%	100%
31.8. Biophilic Environment	23	96%	4%	100%
28.4. Child involvement in afterschool arts and cultural programs	23	91%	9%	100%
29.1. Impact of the school design on existing streetscapes.	23	91%	9%	100%
29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	23	91%	9%	100%
31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	23	91%	9%	100%
31.3. The building has spaces for cultural activities.	23	91%	9%	100%
31.9. The building makes people feel a sense of place, belongingness and rootedness.	23	91%	9%	100%
31.10. The building is designed with adaptability	23	91%	9%	100%
31.11. Learning environments and school culture foster creativity and innovation.	23	91%	9%	100%
28.3. Arts Education is included in the curriculum.	23	87%	13%	100%
29.5. Respecting socio- cultural identity and context: Projects should help to enhance local culture, habits and traditions, while accepting that it may sometimes be appropriate to work to help to change the culture of any given locality.	23	87%	13%	100%
31.2. Availability of short- term and episodic cultural venues and events	23	87%	13%	100%
29.2. The building reflects collective memories and protects the local history and character of a place.	23	86%	14%	100%
27.2. Freedom of expression: Ability for all individuals to enjoy the right and opportunity to speak, write, and create, among others.	23	83%	17%	100%
27.3. Public expenditure, at the Dept. of Education of P.R. and/or School level, in support of arts and cultural activities.	23	83%	17%	100%
27.4. Amount of money spent by school community members on cultural activities, goods and services	23	83%	17%	100%

27.5. Philanthropic expenditures in support of arts and culture.	23	83%	17%	100%
27.6. Academic Integrity: Raise awareness on plagiarism, academic ethics and scholarly values.	23	83%	17%	100%
28.2. Professional Training in cultural and creative fields.	23	83%	17%	100%
28.5. Explicit public policies about arts and culture	23	83%	17%	100%
30.6. Gender equality: Provision and perception of equal opportunities and rights between women and men in terms of education and labor force participation.	23	83%	17%	100%
31.7. Integrate public art and local artists in the school (Ex. exhibits).	23	83%	17%	100%
27.1. Access to the internet, particularly for cultural and creative content.	23	78%	22%	100%
28.1. Multilingual Education	23	78%	22%	100%
28.6. Participation of school members in cultural governance	23	78%	22%	100%
30.4. Participation in cultural activities	23	78%	22%	100%
31.4. Provide a space for communal meals.	23	78%	22%	100%
28.7. Administer a Post- Occupancy Cultural Evaluation to school members to inquire about cultural communication, education, governance, economy, participation, heritage, spaces and events.	23	74%	26%	100%
30.2. Volunteering and personal support of arts and cultural activity	23	74%	26%	100%
31.13. Aesthetic quality of the building	23	74%	26%	100%

Recategorization of indicators:

Very Important + Important= YES

Somewhat Important + Not Important= NO

Criteria: More than 70% of professionals indicated YES + Mean 3.25 or higher

Reference studies: (Green, 1982; Naughton, B., et.al, 2017; Walsh, V., et.al., n.d.)

Conclusions: 20 indicators previously identified were categorized as YES by more than 70% of professionals

APPENDIX P: DETERMINE CONSENSUS OF OPINION AMONG EXPERTS (ANALYSIS #4)

Indicator (Abbreviated)	Relative Frequency				Mean Rank	Std. Dev.	Consensus	Category
	Very Imp. (4)	Imp. (3)	Somewhat Imp. (2)	Not Imp. (1)				
31.14. Neighborhood Facilities	0.74	0.26	0.00	0.00	3.74	0.43	0.80	Cultural Spaces and Events
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	0.74	0.22	0.04	0.00	3.70	0.55	0.75	Cultural Heritage
31.13. Aesthetic quality of the building	0.74	0.22	0.04	0.00	3.70	0.57	0.75	Cultural Spaces and Events
31.9. The building makes people feel a sense of place, belongingness and rootedness.	0.61	0.39	0.00	0.00	3.61	0.49	0.75	Cultural Spaces and Events
31.11. Learning environments and school culture foster creativity and innovation.	0.78	0.13	0.09	0.00	3.70	0.63	0.73	Cultural Spaces and Events
31.3. The building has spaces for cultural activities.	0.61	0.35	0.04	0.00	3.57	0.59	0.71	Cultural Spaces and Events
29.2. The building reflects collective memories and protects the local history and character of a place.	0.30	0.52	0.09	0.04	3.14	0.79	0.68	Cultural Heritage

31.5. Open Space	0.61	0.30	0.09	0.00	3.52	0.67	0.67	Cultural Spaces and Events
31.6. Joint Use of Facilities	0.70	0.22	0.04	0.04	3.57	0.80	0.61	Cultural Spaces and Events
29.4. Raise awareness of the building's heritage value [...]	0.57	0.35	0.04	0.04	3.43	0.80	0.61	Cultural Heritage
29.1. Impact of the school design on existing streetscapes.	0.61	0.30	0.04	0.04	3.48	0.80	0.60	Cultural Heritage
31.1. Cultural Diversity	0.48	0.43	0.00	0.09	3.30	0.89	0.57	Cultural Spaces and Events
29.5. Respecting socio- cultural identity and context	0.43	0.43	0.04	0.09	3.22	0.92	0.56	Cultural Heritage
28.4. Child involvement in afterschool arts and cultural programs	0.57	0.35	0.00	0.09	3.39	0.90	0.54	Education
31.7. Integrate public art and local artists in the school	0.35	0.30	0.30	0.04	2.96	0.95	0.54	Cultural Spaces and Events
31.2. Availability of short- term and episodic cultural venues and events	0.43	0.39	0.09	0.09	3.17	0.96	0.54	Cultural Spaces and Events
29.6. The building involves traditional materials, craftsmanship and techniques	0.30	0.30	0.35	0.04	2.87	0.92	0.54	Cultural Heritage
31.4. Provide a space for communal meals.	0.65	0.26	0.00	0.09	3.48	0.91	0.54	Cultural Spaces and Events
31.12. Spiritual enrichment	0.43	0.35	0.13	0.09	3.13	0.96	0.52	Cultural Spaces and Events

27.4. Amount of money spent by school community members on cultural activities, goods and services	0.43	0.39	0.04	0.13	3.13	1.04	0.50	Economy
31.10. The building is designed with adaptability	0.48	0.39	0.00	0.13	3.22	1.02	0.50	Cultural Spaces and Events
28.7. Administer a Post-Occupancy Cultural Evaluation to school members	0.39	0.35	0.13	0.13	3.00	1.07	0.49	Governance
28.6. Participation of school members in cultural governance	0.43	0.35	0.09	0.13	3.09	1.05	0.48	Governance
28.5. Explicit public policies about arts and culture	0.48	0.35	0.04	0.13	3.17	1.04	0.47	Governance
31.8. Biophilic Environment	0.48	0.26	0.17	0.09	3.13	1.02	0.47	Cultural Spaces and Events
28.3. Arts Education is included in the curriculum.	0.57	0.30	0.00	0.13	3.30	1.03	0.46	Education

Criteria: Complete agreement = 1; Complete disagreement = 0

Reference studies: Tastle, W., & Wierman, M. (2007).

Conclusion:

- A total of 13 indicators comply:
 - 4 indicators already in LEED to be revised
 - 9 new indicators to be developed
 - 7 indicators with less than 50% consensus were eliminated

APPENDIX Q: SAMPLE THEMATIC ANALYSIS INTERVIEWS (EXCERPT)

This table shows an example of the qualitative analysis performed of participant interviews, following [Watts \(2014\)](#).

Design intention: Which architectural elements employed in the school design contribute to the expression of P.R. culture? (Q11)									
Case studies	Architectural Mechanism (Parsaee et al., 2015)								
	Spatial Organization			Physical Structure					
	Circulation	Space org. & sequence/ Functional areas	Distribution of public/ private zones	Climatic features	Bldg. Config. (overall size and shape)	Prop. & scale	Material & Color	Orn. & Details	Non-visual qualities
School A			Another strategy we used was to segregate spaces because we had such an extensive program ... The school was divided into public and private areas and then by levels ... the middle school was located on the third level, the elementary	Using interior patios as part of the organizational scheme is always quite practical apart from the fact that culturally we like open corridors, natural ventilation, that kind of thing that with a "double loaded" corridor you would not	The shape of the school was somewhat tied to a sketch developed by the architect [...] he saw the school as something very rigid and wanted it to be well structured [...] it was a completely orthogonal scheme that basically comes out of a linear	you can have different patio environments on different scales. In this case, one roofed and then two others, a smaller one that has a small amphitheater and then the other one that is a completely green area where the library and the spaces	The 21st century program already had selected color palettes, we did not have the freedom to select the tones [...] we used the different colors they gave us as a base and to highlight some		...we tried to create spaces that encourage the community to share and gather together... and that the building spaces are part of what people already see as their place, their home, their space ... beyond what perhaps

			<p>school in the second level and the first was divided in two. Common public areas were located near the entrance and the elementary, while the first, second, third grade and kindergarten were located on the other half with direct access to the playground.</p>	<p>be able to achieve.</p> <p>- Certainly, in cultural terms I'd say yes due to the fact that corridors open to the outside, classrooms have operable windows to promote cross ventilation, eaves to protect the windows from water and sun [...]</p> <p>Building orientation:</p> <p>... the majority of the rooms that are used daily,</p>	<p>distribution of space.</p> <p>Also, the school had a relatively small lot for the program they were asking for. They were asking for an extensive building program, a 750 student school from kindergarten through ninth grade. It was impossible to fit all the program requirements in two levels so these limitations forced us to design a three-level school.</p>	<p>around it face the patio. There are three courtyards, what happens is that the basketball court, for practical purposes, is like a roofed patio.</p>	<p>elements of the design or the entrance of the school, etc. We tried to keep the rest of the school quite neutral trying to avoid it becoming a cliché</p>		<p>happens in traditional school buildings that one has buildings scattered everywhere and there is no sense of belonging to their space and in this case, yes, I think that is something we achieved</p>
--	--	--	---	--	---	---	--	--	---

				<p>we located them towards the Northeast so that they had the best solar exposure, that is, there are rooms on the opposite side but they are rooms that are used less frequently, for example, an art or a dance room, classes that are itinerant that you do not necessarily have a group in that room all the time and the administrative area and others that</p>	<p>The school is organized around its inner courtyards. In that sense, we understand that it is a fairly traditional concept here in Puerto Rico.</p>				
--	--	--	--	---	---	--	--	--	--

				<p>had air conditioning . Therefore, we preferred to locate naturally ventilated spaces towards the best exposure.</p> <p>-Also, the interior patios and the tall roof from the "community pavilion" also helped a lot so that the ventilation could be distributed throughout the property.</p>					
School B	there is sociability because the corridors	Openings to the outside, the visibility of the patio		Operable windows. Ventilated hallways. In	In the courtyard school concept. The		So the modelling clay... the personal	Interest of working the facade concerned	

	<p>face the inside, not the outside. The hallways lead to the patio. That makes everyone look at themselves and see the activity. So, the patio has wide corridors ... expansiveness... the school feeling like a place where people can go back and forth through the corridors and they are not stumbling ... Corridors take advantage of the natural</p>	<p>from the moment you enter the school and the wide corridors.</p>		<p>the joints of the different bays there are stairs where there is ventilation.</p>	<p>patio school... the patio as a place of sociability. In Puerto Rico, it is particularly interesting because the patio is a spatial element that makes the leap, meaning that you find it from "Spanish colonial" architecture up to Modernity [...]</p> <p>the school organized around an inner courtyard. So the school becomes the patio and the walls are</p>		<p>level, the generational experience ...</p> <p>-Use of color to emulate modeling clay.</p>	<p>with themes of light, shadow, contrast and low relief. On the surface of the school we designed a detail using corrugated zinc plates</p> <p>-the treatment of the corner and the surface in low relief with the corrugated zinc panels</p> <p>On an architectural level, again, the recognition of the corner as the meeting of two planes</p>	
--	---	---	--	--	--	--	---	---	--

	<p>context and temperature in Puerto Rico. Covered, without sun, for much of the day to make them more comfortable.</p>				<p>what define that space</p> <p>- in this case the school canteen is the round piece, it is the identity piece, it is the piece that distinguishes this school from others. At one point, although many people still continue to do so, all schools became very similar. We wanted to be sure that there was a component of the school that was the one that awakens or detonates a little bit in the memory</p>			<p>that, as such, it is different from the rest of the planes [...]</p> <p>[...] in the Caribbean tradition there is also that ... the corner as that occasion of meeting that the architect should design and we saw this in other schools. So, it is all part of inserting yourself into the architectural legacy that, you know, is what I have always been interested in.</p>	
--	---	--	--	--	--	--	--	---	--

					... this is the peculiarity of my school ... I am in a school that is different from another.				
--	--	--	--	--	---	--	--	--	--

APPENDIX R: SUMMARY OF MODIFICATIONS TO THE PPS PLACE GAME TOOL FOR THE PROFESSIONALS SURVEY

SUMMARY OF MODIFICATIONS TO THE PPS PLACE GAME TOOL (PPS, 2005) FOR THE PROFESSIONALS SURVEY		
PPS (PLACE GAME)- ORIGINAL (PPS, 2005)	MODIFIED VERSION FOR SCHOOLS- SURVEY	COMMENTS
COMFORT & IMAGE		
Overall attractiveness	Attractiveness	
Feeling of safety	Feeling of safety in the school	
Cleanliness/Quality of Maintenance	----	Eliminated for the professional's survey. Not a strategy that could be employed by professionals. Could be included in user survey.
Comfort of places to sit	Comfort of places to sit	
---	Quality views	Added
ACCESS & LINKAGES		
Visibility from a distance	Visibility from a distance (street presence)	Added "street presence"
Ease in walking to the place	-Bicycle access and facilities in school -Access to quality transit (Bus, train)	Revised
Transit access		
Clarity of information/signage	Clarity of information/signage	
USES & ACTIVITIES		
Mix of stores/services	Health (Promote increased physical activity by providing play and recreation facilities) Health (Access to fresh food, Ex. School garden)	Revised to adapt for schools
Frequency of community events/activities	Provision of spaces for socio-cultural activities	
Overall busy-ness of area	Build and support local economy (Small scale entrepreneurship, economic development, promote higher real estate values)	Revised and merged into one item
Economic vitality		
SOCIABILITY		
SOCIABILITY & PARTICIPATION		
Number of people in groups	Foster social interactions between people	Modified the title and items to include user participation
Evidence of volunteerism	Promote school and community relations	

Sense of pride and ownership	Promote a sense of pride and ownership among community members (Identity and sense of belonging)	Revised to adapt for schools
Presence of children and seniors	Collaborative (Participation of users, architects and community leaders in decision making processes)	
DESIGN		
----	Inclusivity (Accessibility, places everyone can use)	Added new category based on the Project for Public Spaces (2009) Place making definition and on the Dumfries and Galloway Council (2018) Design Quality and Placemaking standards.
----	Form supports function	
----	Adaptability (Adapts to changes in use. Ex. Changeable modular structure, reconfigurable sliding walls)	
----	Context-specific design	
----	Trans-disciplinary (Crosses boundaries of two or more disciplines)	
----	Transformative impact (Inspire leaders to make investments that generate social and economic benefit)	

APPENDIX S: INVITATION EMAIL FOR PARTICIPANTS AND RSVP FORM

LEED CERTIFIED SCHOOLS FOR THE 21st CENTURY- ONLINE FOCUS GROUP

You are invited to participate in a virtual Focus Group, which is part of the research project *[Re] Measuring [LEED] Sustainability*, which I am developing, as part of my doctoral studies at Nottingham Trent University (NTU) in the United Kingdom. The purpose of this focus group is to further develop the LEED socio-cultural indicators identified as priorities for Puerto Rico's tropical school context on the design and construction professionals survey previously administered.

Your recommendations will contribute to improve the LEED evaluation tool and the development of pilot credits that could eventually be implemented in future sustainable projects by yourselves and other LEED AP's.

If you interested in participating, please let us know your availability on the following **RSVP form** before November 6, 2020. This will help us determine the event's date/ time during the November 17-20 week. The focus group is expected to last approximately two (2) hours. On the link, you will find the [Informed Consent Form and Focus Group questions](#) so that you can review both documents beforehand. Feel free to jot down any ideas that come to mind in preparation for the online meeting.

The research protocol has been authorized by the NTU Research Ethics Committee. If you have any questions or would like more information about this investigation, you may contact me at 787-XXX-XXXX or eileen.diaz@upr.edu.

Thank you in advance for your time and continued collaboration.

Cordially,

Arch. Eileen L. Díaz, LEED AP (BD+C)

RSVP Form

Name: _____

Years of experience as sustainability consultant: _____

How many LEED projects have you certified: _____

How many of these LEED projects are schools: _____

Please indicate your availability for the focus group:
[Please select all the dates/ times available]

XX November 2020

XX November 2020

XX November 2020

XX November 2020

After all participants confirm their availability, I will send the official invitation with the final meeting date/ time for the Focus Group session. In the meantime, please tentatively reserve selected dates.

APPENDIX T: FOCUS GROUP CONSENT FORM AND NON-DISCLOSURE AGREEMENT



CONSENT FORM AND NON-DISCLOSURE AGREEMENT

FOCUS GROUP

**Research Project:
(Re) Measuring (LEED) Sustainability:
From a Global Rating System to Tropical Specificity**

Description

You are invited to participate in a virtual Focus Group, which is part of the research project *[Re] Measuring [LEED] Sustainability*, which I am developing, as part of my doctoral studies at Nottingham Trent University (NTU) in the United Kingdom. The purpose of this focus group is to further develop the LEED socio-cultural indicators identified as priorities for Puerto Rico's tropical school context on the design and construction professionals survey previously administered. We are asking you to participate in this research, because you were a sustainability consultant in one of the LEED certified schools that were part of the Schools for the 21st Century Program in the Island.

The online meeting is expected to last approximately two (2) hours. As part of this study, you will be placed in a group of 3 – 5 professionals. A moderator will ask you several questions while facilitating the discussion, particularly about new LEED socio-cultural indicators which could be further developed as pilot credits. However, you only need to respond to the questions you want to. The focus group will be audio recorded and transcribed into text form with identifying features removed (e.g. names and places). Relevant quotations may then be included in the final report. All recordings will be stored securely and remain confidential.

Risks and benefits

Your participation does not involve any risks other than what you would encounter in daily life. If you are uncomfortable with any of the questions or topics, you are free not to answer. You will not receive any direct benefit, beyond the satisfaction of having contributed to the improvement of the assessment tool for sustainable buildings in Puerto Rico.

Confidentiality

Personal information or data that can identify you directly or indirectly will be handled confidentially. Unless required by law, only the study investigator and NTU supervisory team have the authority to review your records.

Results of this study may be used for teaching, research, publications and presentations at professional meetings. If your individual results are discussed, then a code number will be used to protect your identity. Anonymized data may be used in other studies in line with the University Research Data Management Policy.

NTU is committed to respecting the ethical codes of conduct of the United Kingdom Research Councils (RCUK) and the European Union *General Data Protection Regulation* (EU GDPR). Thus, in accordance with established procedures, the University will conserve all information and data collected during the research in line with University Policy, consistent with both RCUK, and the EU GDPR (<https://www.ukri.org/about-us/policies-and-standards/gdpr-and-research-an-overview-for-researchers/>).

Data will be anonymized and kept in the NTU Data Archive for 10 years, after the research is finished, in line with the Research Data Management Policy and destroyed in line with the current RCUK/University/GDPR Guidelines. Identifiable data will be deleted.

Rights

If you read this document and decided to participate, please understand that your participation is voluntary and that you have the right to refrain from participating or withdraw from the study, without penalty. If you wish to withdraw your consent please contact me before **December 15, 2020**. In addition, you have the right to receive a copy of this document.

If you have any questions or would like more information about this investigation, please contact Arch. Eileen L. Díaz (787-XXX-XXXX or eidilart@gmail.com) or the research supervisor Dr. Marisela Mendoza (marisela.mendoza@ntu.ac.uk).

If you want to speak with someone who is not directly involved in this research, or if you have questions about your rights as a research subject, contact Professor Michael White, Chair for the College Research Ethics Committee (CREC) for the College of Art Architecture Design and Humanities (CAADH) at NTU. You can send an e-mail to michael.white@ntu.ac.uk.

Non-Disclosure Agreement

The topics, ideas, concepts and focus group discussions represent Confidential Information of this research study. By signing this consent form, you agree:

- To hold in confidence the information about the research project which is disclosed, or made available to you directly or indirectly.
- That any ideas or suggestions contributed by you or others during the discussion,

shall be the property of the principal researcher.

- That you, shall not make any use of the Confidential Information provided to you beyond those activities that are part of the Focus Group.
- To Respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

The consent form will be discussed before beginning the Focus group session and you will be asked to indicate whether or not you agree to participate in this investigation by indicating your decision on the MS Teams chat tool:

By writing **“Agree”** you certify that the Consent Form was discussed and any questions you had were answered to your satisfaction. Also, that **you agree to maintain the confidentiality of the documents and information received, observed and/or discussed as part of the focus group session.**

If you do not agree to participate, you may leave the meeting without penalty.

APPENDIX U: FOCUS GROUP SCRIPT AND QUESTIONS

I. Welcome

Good afternoon and welcome to our session. Thank you for taking the time to join us to talk about the development of LEED sociocultural credits for the Puerto Rico context. My name is Eileen Díaz and this focus group is part of my PhD project titled: [Re]measuring LEED Sustainability in Nottingham Trent University in the U.K. You were invited because you were a Sustainability Consultant (LEED AP) for the Schools for the 21st century project.

The purpose of this meeting is to discuss and further develop the LEED socio-cultural indicators identified as priorities for local schools on the design and construction professionals survey you participated in. Also, discuss the strategies and credit requirements that could be implemented for the local context. Once this research project is published, socio-cultural credits may be used by LEED AP's as yourselves for inclusion in your own projects.

My role as moderator will be to ask you several questions and guide the discussion. There are no right or wrong answers but rather differing points of view. Out of respect, please refrain from interrupting others. However, feel free to be honest even when your responses counter those of other group members.

Please keep your microphones on mute to avoid background noises and unmute them when you want to participate. Also, you can raise your hand to ask for a turn and/or use the chat tool.

At times, participants will be called on individually. Respondents can then either answer when called upon, or say "pass" if they do not wish to answer the question.

We will be audio recording the session because we don't want to miss any of your comments. People often say very helpful things in these discussions and we can't write fast enough to get them all down. Today, we will be on a first name basis, but we won't use any names in our final report.

[Consent Form and Non-Disclosure Agreement discussion: Form will be shared on screen and discussed with participants. Any questions they might have regarding the document will be answered. Participants will be asked to indicate whether or not they agree to participate in this investigation by indicating your decision on the MS Teams chat tool].

Well, let's begin. Please tell us your name and the name of the 21st school(s) you certified.

II. Focus Group Questions

1. Which of the following indicators would you have attempted as a pilot credit under the Innovation category to certify your 21st century school project as Building Design and Construction (BD+C) and what implementation strategy and documentation requirements would you propose for each of the selected credits? (Please select all indicators that apply from Table 1)

2. If you were to re-certify your 21st century school project(s) under LEED Operations and Maintenance (O+M), which of the following pilot credits would you attempt and what implementation strategy and documentation requirements would you propose for each of the selected credits? (Please select all indicators that apply from Table 1)

3. Can you identify which of the following credit and documentation requirements in SAS worldwide apply to the P.R. school context? (Please refer to “thematic analysis” rows on table 2).

Table 1: Pilot Credit List

Proposed Socio-cultural Indicators	Category
28.4. Child involvement in afterschool arts and cultural programs	Education
29.1. Impact of the school design on existing streetscapes.	Cultural Heritage
29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	Cultural Heritage
31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	Cultural Spaces and Events
31.3. The building has spaces for cultural activities.	Cultural Spaces and Events
31.9. The building makes people feel a sense of place, belongingness and rootedness.	Cultural Spaces and Events
31.11. Learning environments and school culture foster creativity and innovation.	Cultural Spaces and Events
31.4. Provide a space for communal meals.	Cultural Spaces and Events
31.13. Aesthetic quality of the building	Cultural Spaces and Events

**Table 2: Proposed Pilot Socio-cultural Indicator: Education
Child involvement in afterschool arts and cultural programs**

[Sample table: One table will be included for each of the nine (9) pilot credits. This table will be shared on screen and filled by the main researcher during the meeting to include participant's recommendations.]

28.4. Child involvement in afterschool arts and cultural programs				
School name				
New Construction (BD+C) Proposed Credit Requirements				
New Construction (BD+C) Proposed Documentation Requirements				
Operations and Maintenance (O&M) Proposed Credit Requirements				
Operations and Maintenance (O&M) Proposed Documentation Requirements				
Thematic analysis: Sustainable Assessment Systems (SAS) worldwide, survey and interviews: Credit Requirements	<ul style="list-style-type: none"> Extend school hours (programming) 			
Thematic analysis: Documentation Requirements	<ul style="list-style-type: none"> Arts Instruction per Week Teachers Dedicated to Visual Arts, Music, and Theatre, etc. % of children involved in afterschool programs. Survey or enrolment (CV in Comm.). 			
Comments				

Project phase impacted by credit: (Please select all that apply)	Pre-design planning	Design	Construction	Operations (Establishment)	Operations (Ongoing performance)

Please rate your proposal compared to other LEED credits:			
	Smaller Impact than typical LEED credits	About the same as typical LEED credits	Larger impact than typical LEED credits
Positive environmental impact			
Number of team members who need to be involved			
Amount of time needed to complete this credit			

4. Which modifications to the implementation strategy and/or documentation requirements would you propose to better adapt the following LEED **existing credits** to the P.R. school context and strengthen its socio-cultural component? (Please select all indicators that apply from Table 3)

5. Can you identify which of the following credit and documentation requirements in SAS worldwide apply to the P.R. school context? (Please refer to “thematic analysis” row on table 4).

Table 3: LEED Existing Credits

Proposed Socio-cultural Indicators	Category
31.6. Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.	Cultural Spaces and Events
31.14. Neighborhood Facilities: Availability and access to cultural related establishments, venues or organizations.	Cultural Spaces and Events
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	Cultural Heritage
31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.	Cultural Spaces and Events

Table 4: Existing LEED Indicator: Cultural Spaces and Events
Joint Use of Facilities

[Sample table: One table will be included for each of the four (4) LEED existing credits. This table will be shared on screen and filled by the main researcher during the meeting to include participant’s recommendations.]

Proposed Recommendations to LEED Existing Credit: 31.6. Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.				
CURRENT Credit Requirements (Summary)	<ul style="list-style-type: none"> Option 1: Make at least 3 of these building spaces open to general public: auditorium; gymnasium; cafeteria; classrooms; playing fields and stadiums; and joint parking. Provide toilet access. OR Option 2. Contract with specific organizations to share building space OR Option 3. Use shared space owned by other organizations. Provide pedestrian access. 			
CURRENT Documentation Requirements (Summary)	Provide signed agreements, floorplan and/or site plan.			
School name	School A	School B		
New Construction (BD+C) Proposed Credit Requirements	XXXX			

New Construction (BD+C) Proposed Documentation Requirements	XXXX			
Operations and Maintenance (O&M) Proposed Credit Requirements		XXX		
Operations and Maintenance (O&M) Proposed Documentation Requirements		XXX		
Thematic analysis: Sustainable Assessment Systems (SAS) worldwide, survey and interviews: Credit Requirements	<ul style="list-style-type: none"> • Covered neighbourhood facilities (SBAT) • The provision of community facilities should take into consideration the technology, construction, maintenance and management of services, and should be appropriate to the project's context. (SPeAR) • The school must become the hub of the community and its educational, cultural and social center seven days a week (NS-CAAPPR, 2002:12). • Option 1: Include library and basketball court (FNI); add open spaces • Co-management • Shared spaces must be visible from a distance (consider lighting, materiality, location)- (NE- Entorno) • Architectural shape/ design that visually / spatially promotes community integration. • Spaces adequate to the community based on their needs. 			
Documentation Requirements	<ul style="list-style-type: none"> • Seating capacity as a percentage of number occupants living within 2000m of the building. (SBAT) • Submit evidence of spaces being used by the community, events or activities. Include in LEED online stats? • Evidence of survey or meeting with community to determine shared space needs. 			

Project phase impacted by credit: (Please select all that apply)	Pre-design planning	Design	Construction	Operations (Establishment)	Operations (Ongoing performance)
Please rate your proposal compared to other LEED credits:					
	Smaller Impact than typical LEED credits	About the same as typical LEED credits	Larger impact than typical LEED credits		
Positive environmental impact					
Number of team members who need to be involved					
Amount of time needed to complete this credit					

Table 5: Pilot Credit List

Proposed Socio-cultural Indicators	Category
28.4. Child involvement in afterschool arts and cultural programs	Education
29.1. Impact of the school design on existing streetscapes.	Cultural Heritage
29.4. Raise awareness of the building's heritage value among the school community and general public through signage and educational activities.	Cultural Heritage
31.1. Cultural Diversity: Building encourages cultural exchange between people with different backgrounds.	Cultural Spaces and Events
31.3. The building has spaces for cultural activities.	Cultural Spaces and Events
31.9. The building makes people feel a sense of place, belongingness and rootedness.	Cultural Spaces and Events
31.11. Learning environments and school culture foster creativity and innovation.	Cultural Spaces and Events
31.4. Provide a space for communal meals.	Cultural Spaces and Events
31.13. Aesthetic quality of the building	Cultural Spaces and Events

LEED Existing Credits

Proposed Socio-cultural Indicators	Category
31.6. Joint Use of Facilities: Share school building spaces and its playing fields with the community for non-school events and functions.	Cultural Spaces and Events
31.14. Neighborhood Facilities: Availability and access to cultural related establishments, venues or organizations.	Cultural Spaces and Events
29.3. Encourage the adaptive reuse of school buildings and cultural landscapes, where applicable.	Cultural Heritage
31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.	Cultural Spaces and Events

6. Which of the above credits do you consider irrelevant for the P.R. school context?
7. Are there any additional socio-cultural indicators that were not included but could be added to the list?
8. Which economic, political, social, cultural and/or environmental conditions **support** the application of the LEED certification system in P.R.? (Please name at least two factors)
9. Which economic, political, social, cultural and/or environmental conditions **hinder** the application of the LEED certification system in P.R.? (Please name at least two factors)

APPENDIX V: SAMPLE EXISTING LEED INDICATOR TABLE FILLED LIVE DURING PARTICIPANT INTERVIEWS.

Cultural Spaces and Events Category- Open Space

Existing LEED Indicator: Cultural Spaces and Events

31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.

Proposed Recommendations to LEED Existing Credit: 31.5. Open Space: Create exterior public space, compatible with local cultural values, that encourages interaction with the environment, social interaction and recreation.							
CURRENT Credit Requirements (Summary) LEED SCHOOLS (BD+C)- v.4.1	<ul style="list-style-type: none"> Open Space: Create exterior space that encourages interaction with the environment, social interaction, passive recreation, and physical activities. 						
CURRENT Documentation Requirements (Summary)	<ul style="list-style-type: none"> Provide outdoor space greater than or equal to 30% of total site area. 25% must be vegetated or have vegetated canopy. Comply with one or more of the following: paving or turf area with elements to accommodate outdoor social activities and/ or encourage physical activities; garden space; preserved habitat. Green roofs and ponds may comply. 						
School name and/or participant (code)	Sch. E	Sch. D,H,I	Sch. B	All 21 st C. Sch. Gov. repre. (K1)	Sch. G,J	All 21 st C. Sch. Project Manager (K2)	All 21 st C. Sch. CxA (A3)
Proposed Credit Requirements [Informed Phase 4 Semi-structured interviews]	Imp. Credit. Participatory method: The community should advise on which spaces are needed and its uses. Real state-land values.	Should be a pre-requisite? Integration with programming and structures	Shading pavilions or gazebos. She thinks they used this credit. Trees/ shade	Connection and views (FNI). Exterior classroom, communal spaces and amphitheatre.	Exterior classrooms - ideal for COVID. Views and connection with the interior. Shade.	----	Leave credit as is. Verify if it is included as regional priority for P.R.

	Relevance of external spaces during COVID & earthquake						
Proposed Documentation Requirements			Plans, Area calculation			Schematic drawings. Evidence of meeting with community.	
Thematic analysis: Sustainable Assessment Systems (SAS) worldwide, survey and interviews: Credit Requirements	<ul style="list-style-type: none"> ● Provision of public open space compatible with local cultural values. (SB Tool) ● Strategies for tropical climates: <ul style="list-style-type: none"> ○ Integration between interior and exterior: <ul style="list-style-type: none"> ○ Views and connections ○ Wide open corridors (School Boom- min. 6') ○ Patios/ courtyards used as organizational elements- (S.21) ○ Provide shade and protection from sun (Ex. shading pavilion- s.21-FNI) ("Glorietas", canopy in school entrance- School Boom) ○ Outdoor spaces and landscape design elements consciously designed for learning or as an extension of the indoor learning space (FNI) ● Accessibility 						
Documentation Requirements	N/A						

Sample table. Existing LEED Indicator: Cultural Spaces and Events- Open Space

APPENDIX W: MECHANICAL ENGINEERS- INTERVIEW QUESTIONS

1.1 Please discuss the process/ methodology used to comply with the LEED prerequisite **Minimum Energy Performance** for naturally ventilated spaces in LEED schools:

(Please feel free to present the analysis, energy model images or other relevant documentation available.)

(A direct link to the LEED credit in USGBC Library is included as reference- [V3](#); [V4.1](#))

1.2 How was the baseline determined for the particular case of your certified school?

1.3 Was an energy model developed for the school? If not, how was the energy and IAQ performance demonstrated?

- Participant's comments (Survey):
 - Energy model- "model spaces as if they had A/C"
 - Operable/ Louvered windows, *Brise soleils*- are they included in calculations or model?
 - "An energy model does not represent the value of having unconditioned habitable spaces because they are modelled as the same in the Baseline as well as in the Design Case as per Appendix G of ASHRAE/IESNA 90.1."

Construction Methods:

1.4 How does the selection of building envelope materials and its R-value impact energy performance and energy modeling? Are traditional local materials adequate (Ex.masonry, reinforced concrete, etc.)?

- Participant comments (Survey):

Furthermore, traditional construction methods are based mainly on masonry walls and reinforced concrete for any type of space, mainly because they have always been available local materials used for the building envelope. When air conditioning started being used in the island for specific type of spaces, envelope considerations did not change as the general conception on envelope was that insulation is only needed in cold climates for heating purposes. For this reason, it has been very difficult make the contractors and the team to understand the importance of the envelope's R-value and why it is essential to invest the money in those items. Nevertheless, through several long meetings and constant team interaction, energy model results revealed the importance of envelope considerations.

1.5 Were the proposed louvered/ operable windows in compliance with the minimum required SHGC and U-value factors?

1.6 Do you think that there was any improvement from the Minimum Energy Performance V3 (2009) credit to the actual LEED version 4.1 that favors the use of passive design strategies to earn this LEED credit?

2.1 Please discuss the process/ methodology used to comply with the following LEED requirements for naturally ventilated spaces in LEED schools:

- Minimum IAQ Performance (Link to full LEED credit [V3](#); [V4.1](#))

2.2 Do you think that there was any improvement from the Minimum Energy Performance V3 (2009) credit to the actual LEED version 4.1 that favours the use of passive design strategies to earn this LEED credit?

3. Do you think LEED/ ASHRAE is a suitable for measuring passive design strategies?

- ASHRAE 90.1- Energy Standard for Buildings
- ASHRAE 62.1- Ventilation for Acceptable IAQ
- ASHRAE 55- Thermal Environmental Conditions for Human Occupancy
 - Participant's comments:
 - ASHRAE 55- "Requirements are met if using Air Conditioning"
 - LEED (ASHRAE 62.1) dis-incentivizes natural ventilation

4. Does natural ventilation, patios/ courtyards, awnings, brise-soleils ceiling fans among other passive design strategies contribute to better achieve energy efficiency in compliance with LEED credit requirements?

5. Do you think the following LEED credits are applicable or adequate for the P.R. school context? Please comment.

(Note that the table includes a summary for each credit and comments made by other participants. If necessary, you can also click on the credit name which has a link to view the full credit description on the USGBC Credit Library).

APPENDIX X: LEED CULTURAL SUSTAINABILITY CREDIT GUIDE:
REVISIONS TO EXISTING INDICATORS AND PROPOSED PILOT CREDITS

**LEED Cultural Sustainability
Credit Guide:**

**Revisions to Existing Indicators and
Proposed Pilot Credits**

Indicators resulting from data analysis for PhD thesis:
Eileen Díaz, Nottingham Trent University, June 2023

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List of Abbreviations

ACPs	Alternative Compliance Paths
BCA Green Mark	Building & Construction Authority- Green Mark
BREEAM	Building Research Establishment Environmental Assessment Method
DEPR	Department of Education of Puerto Rico
GRIHA Prakriti	Green Rating for Integrated Habitat Assessment- Existing Day Schools
IC	Impact Category
IP	Interview Participants
LBC	Living Building Challenge
LEED	Leadership in Energy and Environmental Design
LEED AP	LEED Accredited Professional
LEED BD+C	LEED Building Design and Construction
LEED ND	LEED for Neighbourhood Development
LEED O+M	LEED Operations and Maintenance
LT	Location & Transport Category
PC	Pilot Credits
PR	Puerto Rico
QP	Questionnaire Participants
RESET	<i>Requisitos para Edificaciones Sostenibles en el Trópico</i> (Requirements for Sustainable Buildings in the Tropics)
RPCs	Regional Priority Credits
SAS	Sustainable Assessment Systems
SB Tool	Sustainable Building Tool
SBAT	Sustainable Building Assessment Tool
SoB	Sense of Belonging
SoP	Sense of Place
SPeAR	Sustainable Project Appraisal Routine
TERI-GRIHA	The Energy and Resources Institute- Green Rating for Integrated Habitat Assessment
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USGBC	United States Green Building Council

Introduction

The LEED Cultural Sustainability Credit Guide resulted from my PhD thesis project titled [Re] Measuring [LEED] Sustainability: From a Global Rating System to Tropical Specificity at the School of Architecture, Design and the Built Environment at Nottingham Trent University, U.K. The research explored the applicability of the LEED certification system through the case study of Puerto Rico (P.R.), a United States (U.S.) Commonwealth island in the Caribbean, where LEED has become widely recognized as a standard because of the geopolitical relationship with the mainland. Although LEED is used internationally, it was initially developed by the U.S. Green Building Council as a tool to measure building performance in a modern American urban environment with temperate climate, a steady economy and easy access to technology. Furthermore, regionalization strategies such as Regional Priority Credits (RPCs) and Alternate Compliance Paths (ACPs), do not address the sociocultural reality of many regions. Therefore, the focus of this research is to analyse what indicators should be added, modified or substituted to develop a revised LEED model for the specific sociocultural context of P.R.

The *LEED Cultural Sustainability Credit Guide* employs LEED's format and language to present a total of (11) indicators. Five (5) existing LEED indicators were revised, while six (6) were new. This guide details the documentation requirements that would need to be submitted to earn each credit, accompanied by applicable technical information to ensure that these indicators are related to the P.R. context. The guide also includes proposed qualitative and quantitative metrics for the new and revised LEED indicators. A summary of the proposed Pilot Credits and changes to the existing indicators is included on Appendix 2.

Methodology summary

The research methodology employed aims to answer the following research question: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context? The methodology is aligned with the conceptual framework, focusing on *conceived spaces* as defined by design and construction professionals of Puerto Rico's LEED certified schools. Data collection methods and research instruments promoted collaboration between the researcher and professionals through Action Research strategies to propose an agenda for reform to develop indicators to improve cultural vitality in LEED.

Figure 1 illustrates that the methodology employed for the development of the proposed indicators was organized into four (4) main phases. Phase 1 included an in-depth literature review and analysis of LEED in order to determine if the U.S. LEED certification program addresses social and cultural elements as sustainability indicators. An International Comparison of Indicators in school SAS (Phase 2) was performed to compare LEED criteria with international and tropical Sustainable Assessment Systems (SAS) such as BREEAM, the Living Building Challenge, SB Tool, BCA Green Mark (Singapore), RESET (Costa Rica) and TERI-GRIHA (India), among others. This analysis demonstrated that criteria focus mainly on targeting the

environmental dimension of sustainability. This suggested the need to further develop LEED's cultural components, which are overlooked worldwide.

The analysis of LEED indicators and regionalization initiatives by the U.S. Green Building Council (USGBC) informed the implementation strategy for the research findings, which includes the development of Pilot Credits (PC) to better adapt the system to the local context and improve its effectiveness in measuring sustainability in P.R. Also, the literature review performed during this phase included concepts such as cultural vitality and Postcolonialism to better understand the application of LEED in the Island and identify what aspects of sustainability¹ in the tropical Caribbean P.R. region could be incorporated as indicators.

To explore sustainable architecture and the LEED infrastructure in the Island, all ten (10) certified public schools in Puerto Rico were examined, at different stages. During Phase 3a, an online survey was administered to the Architects, Engineers and Sustainability Consultants (LEED AP's) of the selected eight (8) schools on the mainland to inquire about culture and the LEED certification process. The survey accomplished a 76% completion rate (n=23/30).

Five (5) case study schools were then selected for in-depth analysis based on the Department of Education of P.R. Educational Regions distribution. Semi-structured interviews were performed to the five (5) licensed Architects who designed the green schools located in Regions I and II, obtaining a 100% completion rate. The survey and interviews included a cultural assessment of schools in P.R. to investigate cultural identity and expression in the design of case study schools.

An additional round of semi-structured interviews to seven (7) LEED AP's and two (2) mechanical engineers was carried out (Phase 4) to further develop the cultural indicators preliminarily identified as important to the P.R. context in the online survey. In this second round of interviews, there was representation from all ten (10) LEED certified public schools in P.R. Input from Questionnaire Participants (QP) or Interview participants (IP) will be identified throughout the document with a random letter that represents the school name and a number next to it, to protect participant's identity.

Research findings from the above-mentioned techniques informed the proposal of modifications to existing LEED credits and new cultural sustainability indicators adapted for the local context. Placemaking and architectural strategies employed by professionals to define the character or atmosphere of their school projects also informed the development of the proposed credits. Furthermore, Placemaking strategies were integrated into LEED requirements.

¹ Sustainability includes environmental, economic, social and cultural dimensions.

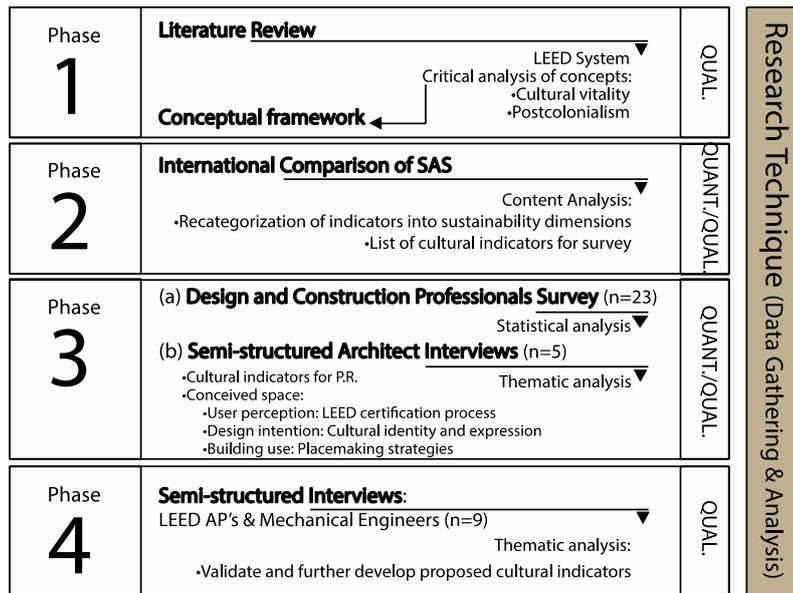


Figure 1: Extract from the methodological framework diagram (by author)

Frequently Asked Questions:

How to navigate this guide?

Based on literature review (Rosario Jackson et al., 2006; Zakariya and et al., 2016), indicators were initially organized into seven (7) cultural vitality categories². However, this guide will feature indicators classified under the following three (3) cultural vitality categories: Cultural Spaces, Heritage and Education, which were selected as most important for the local context by participants on the survey. Then, these were subdivided into *Existing credits with proposed addenda* and *Proposed Pilot Credits*.

Each **existing indicator** is presented following the LEED Credit Library format (USGBC, 2022a), which includes the existing credit language and an Addenda tab, that indicates the credit revisions, location of the text that was modified and description of the change (Figure 2).

However, **Proposed PC** follow the LEED Pilot Credit Application format that includes the credit's name, intent and proposal (credit requirements and documentation requirements) (Figure 3). The guide, includes an additional section titled *Credit Synergies* which details those credits that relate to each other and strategies that could be employed to help project teams earn additional credits. The PhD thesis Chapter 8, provides additional background information for each proposed Pilot Credit and can be consulted at [\(web address of published PhD thesis\)](#).

² This research identified seven (7) cultural vitality components: Cultural spaces and events; Cultural heritage; Education; Communication; Inclusion and participation; Governance and Cultural economy.

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Original image available at: <https://www.usgbc.org/credits/new-construction-core-and-shell-schools-new-construction-retail-new-construction-healthc-161?return=/credits/Schools%20-%20New%20Construction/v4.1>

Figure 2: Top: Screenshot from the LEED Credit Library (USGBC, 2022a). The image on the top left shows the Language tab which includes the existing credit intent and requirements. The image on the top/ right shows the Addenda tab, which indicates the credit revisions, location of the text that was modified and description of the change. Bottom: The image illustrates this guide's format in which the existing credit language is included inside a text box and the proposed addenda is included below, following LEED's format.

How to submit LEED Pilot Credits (PC)?

Proposed cultural indicators included on this guide will be presented using the USGBC Pilot Credit Application format, which includes the justification, strategies, and documentation requirements for each credit (Figure 3). These indicators might later be used by professionals on their future LEED projects or to re-certify existing local schools under LEED's Operations and Maintenance. The LEED Pilot Credit Proposal form is available at: <https://usgbc.wufoo.com/forms/usgbc-member-pilot-credit-proposal/>. PC may be submitted by anyone from a USGBC member organization.

Professionals are invited to use the information on this guide to fill out the PC Application Form and test these indicators in their LEED certified projects. We appreciate that you share your experience or thoughts on these credits with the main researcher via the following email: eidilart@gmail.com.

This image has been removed by author for copyright reasons.
Original image available at: <https://usgbc.wufoo.com/forms/usgbc-member-pilot-credit-proposal/>

Figure 3: Pilot Credit Application Form includes the PC name, intent, and proposal (requirements and documentation requirements).

What is Placemaking and how it is applicable?

The analysis of the LEED Impact Category (IC) and Point Allocation Process Document (Owens et al., 2013) revealed LEED's culture-related components and measures, that could be developed as indicators. One of LEED's key components is to *Create a Strong SoP*, which focuses on developing opportunities to promote social interaction while creating a strong sense of identity with the community (Owens and et.al., 2013:16). The concept of SoP refers to how people perceive, shape, value, appreciate and are attached to places. However, we propose substituting SoP with Placemaking as an operational concept because it portrays an active user, involved in the making of place and its own culture. Placemaking aims to strengthen the connection between people and places, focuses on citizen ownership and capitalizes on local community assets (Project for Public Spaces, 2009).

The Project for Public Spaces (PPS) *Place Game* was used as reference and adapted for schools. This assessment tool allowed survey participants to evaluate Places in five (5) categories: 1) Access and linkages; 2) Sociability; 3) Uses and activities; 4) Comfort and image; and 5) Design. Results contributed to build a 'cultural profile' of schools in P.R. and understand which PM strategies were employed by participants

in local schools, as well as those that could be added as part of the proposed LEED credit requirements. Teams must comply with PM strategies to earn applicable LEED credits.

Cultural Spaces and Events

Cultural Spaces and Events:

Existing Credits with Proposed Addenda

Cultural Spaces and Events

31.5. Open Space

(Existing LEED credit with proposed addenda)

LEED BD+C: Schools (v4.1)

Sustainable Sites category (1 point)

Current LEED Credit Intent (USGBC, 2022b)

"To create exterior open space that encourages interaction with the environment, social interaction, passive recreation, and physical activities."

Proposed Addenda:

Location: Intent

Description of Change: Edit the intent to read as:

To create exterior space compatible with local cultural values and practices that encourages interaction with the environment, socio-cultural exchange, passive recreation, and physical activities.

Current LEED Credit Requirements (Cont.) (USGBC, 2022b)

Provide outdoor space greater than or equal to 30% of the total site area (including building footprint).

At least 25% of the calculated outdoor open space must be vegetated space planted with two or more types of vegetation or have overhead vegetated canopy.

The outdoor space must be physically accessible and be one or more of the following:

- social area: a pedestrian-oriented paving or landscape area that accommodate outdoor social activities
- recreational area: a recreation-oriented paving or landscape area that encourage physical activity;
- diverse green space: a landscape area with two or more types of vegetation that provide opportunities for year-round visual interest;
- garden: a garden space dedicated to community gardens or urban food production; or
- habitat area: preserved or created habitat that meets the criteria of SS Credit Protect or Restore Habitat and also includes elements of human

interaction. These areas automatically meet the vegetation criteria of this credit.

Extensive or intensive vegetated roofs that are physically accessible can be used toward the minimum vegetation requirement, and qualifying roof-based physically accessible paving areas can be used toward credit compliance.

Wetlands or naturally designed ponds may count as open space if the side slope gradients average 1:4 (vertical:horizontal) or less and are vegetated.

Proposed Addenda:

Location: Requirements > Bulleted list > Social area

Description of Change: Statement should read:

The outdoor space must be physically accessible and be one or more of the following:

- social area: provide a pedestrian- oriented paving or landscape area adequate for outdoor socio-cultural activities

Location: Requirements > Bulleted list

Description of Change: Additional recommendations to improve this LEED credit were provided by interview participants, and aligned with the Placemaking Categories Design, Sociability and Participation and Uses and Activities. The list provided could be expanded as follows:

“The outdoor space must be physically accessible and be one or more of the following:”

- Context specific:
 - Climate: For tropical climates, provide protection from the sun and rain through trees, vegetation, canopies and/ or gazebos, among others (IP-J1).
 - Consider the open space location, orientation, size, shape and proportion (Auckland Council, 2022a). Also, the impact of the scale and position of surrounding building in terms of the provision of shade and visual impact, among other relevant aspects.
 - Site integration: Take into consideration the existing site topography in the design of open spaces. For example, sloped terrains can be used to create terraces or bleachers, similar to an amphitheater (IP-C1, D1). This may limit the need to cut and fill the terrain while also providing socialization spaces. Integrate retaining elements as part of the design (Auckland Council, 2022b).
 - Building integration: Open spaces must be integrated to the building program, circulation, and its surrounding structures. Some strategies might include:
 - the provision of interior patios/ outdoor courtyards that may also serve as organizing elements in the floorplan. These open spaces are typically defined by its surrounding buildings and/or circulation routes (IP-A2, C1).

- the provision of transition spaces and elements between the exterior and interior areas such as open corridors, eaves, among others (IP-B2).
 - the specification of doors that allow users to open the classroom and other areas to exterior spaces (IP-K1).
 - maintaining important natural features within the site (Auckland Council, 2022b) while providing visual connections between indoor and outdoor open spaces (IP-C1,D1).
- Accessible: Open space programmatic areas must follow universal design guidelines so that people regardless of age, disability or other factors can use them.
- Collaborative: Employ participatory design methods so that the school community can inform about their programmatic needs and interests for the open space that will be provided. Teams should document and analyse participant's input and modify the design of the project's open spaces as a direct result, or if modifications are not made, explain why community input did not generate any alterations.
- Consciously designed for learning: Provide evidence that outdoor spaces are an extension of the indoor learning space, while also providing protection from the sun and rain (Fielding Nair International, 2010: 24) (IP-A1).

Location: Documentation requirements

Description of Change: Added the following requirements:

Project teams must provide a narrative that describes how the space is compatible with local cultural values and practices. Submit a site plan, the schematic design of the proposed open space and provide area calculations to demonstrate compliance with required percentages (IP-B2, K2).

When using participatory design strategies, project teams must submit a copy of the survey instrument, results, meeting agenda, number of participants and other relevant information (IP-K2).

Credit Synergies:

Project teams can earn extra credits by:

- Lending exterior open spaces to the community during afterschool hours (IP-K1) to earn compatible credits such as *Joint Use of Facilities* (31.6).
- Utilizing outdoor open spaces to provide after school arts and cultural programs (28.4).

Note: Even though initiatives in credit 31.5 may help teams earn additional points, they must follow specific requirements in each of the above-mentioned credits.

Cultural Spaces and Events

31.6. Joint Use of Facilities

(Existing LEED credit with proposed addenda)

LEED BD+C, O+M: Schools (v4.1)

Sustainable Sites category (1 point)

Current LEED Credit Intent (USGBC, 2022a)

“To integrate the school with the community by sharing the building and its playing fields for nonschool events and functions”.

Proposed Addenda:

Location: Intent

Description of Change: Edit the intent to read as: “To integrate the school with the community by sharing the building and its playing fields for nonschool events and functions” (USGBC, 2022b). Encourage user participation and socio-cultural exchange through the provision of spaces and programming strategies.

Current LEED Credit Requirements (USGBC, 2022a)

Option 1. Make building space open to the general public (1 point)

In collaboration with the school authorities, ensure that at least three of the following types of spaces in the school are accessible to and available for shared use by the general public:

- auditorium;
- gymnasium;
- cafeteria;
- one or more classrooms;
- playing fields and stadiums; and
- joint parking.

Provide access to toilets in joint-use areas after normal school hours.

OR

Proposed Addenda:

Location: Requirements > Option 1

Description of Change: Additional socio-cultural spaces that may be lent to the community in the revised credit include the library; computer labs; open-air amphitheatre, exhibition areas, as well as open courtyards or semi-enclosed areas

within them, suitable for cultural activities. In addition, shared spaces must be accessible, following barrier-free or universal design guidelines. Provide independent access to community spaces while providing security for the rest of the school. Consider locating shared spaces close to the entrance to maximize visibility and security (Fielding Nair International, 2010: 30).

A community program should be developed to promote the use and maintenance of these spaces. Project teams are required to evidence community consultation processes carried out to determine the spaces needed by the people. This could be done by administering a survey or holding a meeting with community representatives.

Current LEED Credit Requirements (Cont.) (USGBC, 2022a)

Option 2. Contract with specific organizations to share building space (1 point)

In collaboration with the school authorities, contract with community or other organizations to provide at least two types of dedicated-use spaces in the building, such as the following:

- commercial office;
- health clinic;
- community service centers (provided by state or local offices);
- police office;
- library or media center;
- parking lot; and
- one or more commercial businesses.

Provide access to toilets in joint-use areas after normal school hours.

OR

Proposed Addenda:

Location: Requirements > Option 2

Description of Change: Provide independent access to community spaces and provide security for the rest of the school. Consider locating shared spaces close to the entrance to maximize visibility and security (Fielding Nair International, 2010: 30).

Current LEED Credit Requirements (Cont.) (USGBC, 2022a)

Option 3. Use shared space owned by other organizations (1 point)

In collaboration with the school authorities, ensure that at least two of the following six types of spaces that are owned by other organizations or agencies are accessible to students:

- auditorium;

- gymnasium;
- cafeteria;
- one or more classrooms;
- swimming pool; and
- playing fields and stadiums.

Provide direct pedestrian access to these spaces from the school. In addition, provide signed joint-use agreements with the other organizations or agencies that stipulate how these spaces will be shared.

Proposed Addenda:

Location: Requirements > Option 3

Description of Change: In addition to providing pedestrian access from the school, also offer alternate means of transport and/ or parking to make these spaces more accessible for its users.

Location: Requirements > Option 4 (new)

Description of Change: Added a fourth option that states: Sign a co-management agreement of shared spaces between the school and other organizations (including non-profits, municipal agencies, among others). Provide an administrative office with storage for its administrators.

Location: Documentation Requirements

Description of Change: Added the following requirements:

Building Design and Construction (BD+C):

Currently LEED requires submission of signed agreements, floorplan and/or site plan. Participants recommended also requiring project teams to provide evidence that there was community participation to determine spatial needs (IP- K2). This could be done by submitting survey results, a copy of the meeting presentation and/or meeting minutes.

Also, submit a plan or narrative that explains (1) how the building will be secured and how personal security will be provided to users, particularly when spaces are lent after school hours; (2) recurring maintenance strategies (IP-B2); (3) how the spaces will be advertised to the school community and proposed activities that might be carried out during the first year. Indicate the procedure of how the community will be able to reserve these spaces; (4) training plan for school directors and supporting personnel in charge of shared spaces.

Operations and Maintenance (O+M):

It is important to point out that even though the Joint-use credit was available for LEED for Schools O+M in previous versions, it was eliminated and is currently only available for BD+C. However, research findings point to the reactivation of this credit

for O+M and its revision. This credit might benefit existing schools that have the spaces available and may want to strengthen the use of these venues by the community.

In addition to compliance with the requirements for BD+C, teams applying for this credit under O+M, must (1) provide evidence that existing spaces are being used by the community by submitting a plan with proposed activities that might be carried out in these cultural spaces during the first year and/or (2) provide evidence of the relationship between the use of these spaces and the school's educational curriculum, teaching plans and/or course syllabi, among others (IP-K1).

Credit Synergies:

Project teams can earn extra credits by:

- Utilizing cultural spaces to provide after school arts and cultural programs (28.4)
- Designing the school canteen or space for communal meals as a multipurpose area for cultural activities (31.4)
- Designing cultural outdoor Open Spaces (31.5)

Note: Even though initiatives in Joint Use (31.6) may help teams earn additional credits, they must follow specific additional requirements in each of the above-mentioned credits.

Cultural Spaces and Events

31.14. Surrounding Density and Diverse Uses

(Existing LEED credit with proposed addenda)

LEED BD+C: Schools (v4.1)

Location and Transportation category (Possible 5 points)

Current LEED Credit Intent (USGBC, 2022c)

To conserve land and protect farmland and wildlife habitat by encouraging development in areas with existing infrastructure. To support neighborhood and local economies, promote walkability, and low or no carbon transportation, and reduce vehicle distance traveled for all. To improve public health by encouraging daily physical activity.

Proposed Addenda:

Location: Intent

Description of Change: Edit the intent to read as:

“To conserve land and protect farmland and wildlife habitat by encouraging development in areas with existing infrastructure. To support neighborhood and local economies, access to cultural experiences, promote walkability, and low or no carbon transportation, and reduce vehicle distance traveled for all. To improve public health by encouraging daily physical activity”.

Current LEED Credit Requirements (USGBC, 2022c)

Option 1. Surrounding Density and Connectivity (2–3 points)

Path 1. Surrounding Density

Locate on a site whose surrounding existing density within a ¼-mile (400-meter) offset of the project boundary meets the values in Table 1. Use either the “separate residential and nonresidential densities” or the “combined density” values.

Table 1a. Points for average density within 1/4 mile of project site (IP units)

Combined density	Separate residential and nonresidential densities		Points BD&C	Points BD&C	Points ID&C
Square feet per acre of buildable land	Residential density (DU/acre)	Nonresidential density (FAR)			
22,000	7	0.5	2	2	3
35,000	12	0.8	3	4	6

Table 1b. Points for average density within 400 meters of project site (SI units)

Combined density	Separate residential and nonresidential densities		Points BD&C	Points BD&C	Points ID&C
Square meters per hectare of buildable land	Residential density (DU/hectare)	Nonresidential density (FAR)			
5,050	17.5	0.5	2	2	3
8,035	30	0.8	3	4	6

DU = dwelling unit; FAR = floor-area ratio. Physical education spaces that are part of the project site, such as playing fields and associated buildings used during sporting events only (e.g., concession stands) and playgrounds with play equipment, are excluded from the development density calculations. OR

Path 2. Connected Site

Locate the project on a previously developed site that also meets one of the connected site conditions listed below.

Table 2. Points for connected site

Type of Site	Points
Adjacent	1
Infill	2

- To qualify as an adjacent site, at least 25% of the project boundary must border parcels that are previously developed sites.
- To qualify as an infill site, at least 75% of the project boundary must border parcels that are previously developed sites.
- Bordering rights-of-way do not constitute previously developed land; it is the status of the property on the other side of the right-of-way that contributes

to the calculation. Any part of the boundary that borders a water body is excluded from the calculation.

AND/OR

Option 2. Diverse Uses (1–2 points)

Construct or renovate a building or a space within a building such that the building’s main entrance is within a ½-mile (800-meter) walking distance from the following number of uses (see Appendix 1), as listed below.

Table 1. Points for proximity to uses

Uses	Points
4–7	1
≥ 8	2

The following restrictions apply.

- A use counts as only one type (e.g., a retail store may be counted only once even if it sells products in several categories).
- No more than two uses in each use type may be counted (e.g. if five restaurants are within walking distance, only two may be counted).
- The counted uses must represent at least three of the five categories, exclusive of the building’s primary use.

Proposed Addenda:

Location: Option 2 > Diverse Uses

Description of Change: Add the following restrictions:

- Teams that choose to include civic and community facilities such as: community or recreation centre, cultural arts facility (museum, performing arts), education facility, place of worship and public parks to demonstrate Option 2 compliance (USGBC, 2022c), must follow the **Sociability and Participation** Placemaking strategy to promote school and community relations. Considering neighborhood civic and open spaces can enrich student experience while also strengthening links with the community, these amenities should be used to complement existing school resources and provide activities for students during and after school hours (IP-A3,B2,K1,K2). These school activities should be integrated with the curriculum (IP-K2).

Project teams should provide a narrative explaining the link between neighboring spaces and school activities, proposed curriculum, and the site plan demonstrating compliance with the required distances and facilities access from the school. Provide signed joint-use agreements with neighborhood cultural organizations that stipulate how these spaces will be shared.

- Following the **Access and Linkages** Placemaking strategy, teams must demonstrate that there is pedestrian access and/or public transportation from the school to civic and cultural spaces (IP-K2).

Current LEED Requirements (Cont.) (USGBC, 2022c)

Option 3. Walkable Location (1-5 points BD+C)

Locate on a site with a Walk Score or equivalent third-party walkability assessment for the following thresholds, as listed below.

Table 1. Points for walkable location

Walk Score	Points	Points (Core & Shell)	Points (Healthcare)
90-100	5	6	-
80-89	4	4	-
70-79	3	3	-
60-69	2	2	-
50-59	1	1	-
≥ 50	-	-	1

Projects attempting Option 3 are not eligible to earn points under Option 1 or Option 2.

Credit synergies:

Both the *Surrounding Density and Diverse Uses*, as well as the *Joint Use of Facilities* credit aim to promote school and community relations. However, the first focuses on letting school members benefit from using neighboring facilities, while the latter emphasizes on lending spaces within the school premises to the external community.

Cultural Spaces and Events:

Proposed Pilot Credits

Cultural Spaces and Events

31.4. Provide a Space for Communal Meals
(1 point under the Innovation Category: BD+C Schools)

Intent

Provide a space for communal meals where occupants can sit for meals, gather, and socialize.

Requirements

For LEED **BD+C** initial certification projects, this pilot credit is available for one (1) point under the Innovation Category.

To earn this LEED indicator, teams must demonstrate compliance with one (1) of the following options under the Uses and Activities, Design OR Sociability and Participation Placemaking strategies:

Option 1: Uses and activities: Extension of the school canteen seating areas to adjacent exterior and/ or semi-covered areas

Provide additional exterior and/ or semi-covered seating areas adjacent to the school canteen, benefiting from the tropical climate (IP-I1). Include outdoor tables, gazebos, steps or other furniture where users can sit down for lunch, group projects or socializing. These spaces could also be lent to the community for meetings and other events. Provide shade and protection from the rain.

For Option 1, teams must submit a narrative explaining how the school canteen relates to these supporting spaces (IP-I1). Also, provide a plan marking up the communal space and a furniture layout with numbered seats and tables. It is recommended that a minimum seating capacity is established depending on the number of students. For example, a minimum of 100 seats in a 300-500 student school was used as a guideline for local schools ([Fielding Nair International, 2010: 27](#)).

OR

Option 2. Design for Adaptability: Multifunctional space

Design the school canteen as a multifunctional space by including flexible and movable furniture with casters and wheels, stackable chairs, and pull-top tables (IP-I1, J1, K1). This strategy allows for adaptability and changes to the space when

required depending on the activities that will be carried out (Fielding Nair International, 2010: 65). These spaces could also be used for cultural and extracurricular activities (IP-A3, I1, K1). To achieve this, it is important that the kitchen/ preparation area can be closed-off from the dining area when necessary, and adequate furniture storage is provided (IP-K1, K2). In addition to providing a floorplan, furniture layout, and specifications, teams targeting this option must explain in a narrative format the multiple functions that will be fulfilled by the school canteen.

OR

Option 3: Sociability and Participation: Community Dining Room

In addition to being a potential cultural communal space, food service in public schools plays a relevant role in the Island during emergencies and disaster recovery. Schools to be used as community centres to provide water, food and other supplies to citizens must locate the kitchen and school canteen in a place that is accessible by car or closer to the school entrance, as well as properly integrating a drive through window to facilitate food pickup (IP-B2, J1, K2).

Schools that want to target Option 3, must develop a protocol for food preparation and distribution during emergency and disaster recovery. Including, but not limited to, how the school director will identify the number of students that require the service; number of required personnel; an architectural plan that illustrates the kitchen and school canteen location, while also indicating the pedestrian and vehicular access route for food pickup.

Credit Synergies

In addition to identifying a credit synergy with *Joint Use of Facilities* for sharing the canteen with the school community, IP-E2 commented that it is important to teach students about food security through the O+M Sustainable Sites Category *Local Food Production* indicator as a complement to the proposed Communal Meals credit.

Cultural Spaces and Events

Theme on survey: 31.9. The building makes people feel a sense of place, belongingness, and rootedness.

Proposed indicator title:

31.9. School Community Sense of Belonging

(1 point under the Innovation Category: BD+C, O+M Schools)

Intent

Strengthen the user's Sense of Place and Belonging by providing opportunities, projects and spaces that promote school community ownership and participation in decision making processes.

Requirements

For LEED **BD+C** initial certification projects and LEED **O+M**, this pilot credit is available for one (1) point under the Innovation Category.

Project teams must comply with the **Community participation in decision making processes** requirement and one (1) out of the two (2) **Sociability and Participation** Placemaking paths below.

Community participation in decision making processes (Required):

Schools are required to have an active community/ parent/ teacher's association or equivalent. to promote communication and interaction between its members. They can participate in the development and implementation of plans for school design, improvement and maintenance, as well as the development of sustainability initiatives.

AND

Teams must demonstrate compliance with one (1) of the following **Sociability and Participation** Placemaking paths that aim to strengthen school identity and community pride:

- **Path 1:** Develop projects and spaces that the school community can take ownership of. For example, arts projects, gardens, etc. Invite the school community to participate actively in the development, construction and/or maintenance of these projects. Demonstrate that these activities are:
 - linked with the socio- economic activities and identity of the surrounding community (IP-J1) AND/ OR
 - linked to the curriculum or school theme (IP-A3) AND/ OR

- integrated with the landscape (International Living Future Institute, 2014; Wu et al., 2016: 71)

OR

- **Path 2:** Display elements of community ownership near the vestibule such as a gallery of historic photos, activities or past graduates, student work and awards, among others (Fielding Nair 2010: 19).

Documentation requirements

Submit a plan that includes historical, cultural, ecological, and climatic studies that examine the project site and context (International Living Future Institute, 2014: 40). The plan should include and evidence community/ parent/ teacher participatory processes, and its results must inform building design, operations, or maintenance, depending on the project phase (IP-E2). For example, community input may inform the projects that will be developed, the strategies that will be proposed and the cultural, social, and environmental aspects that will be prioritized for compliance with this credit.

Submit a narrative with a list of strategies, as well as an implementation plan that considers applicable social, cultural, economic, and environmental considerations. Include a site plan or floorplan indicating where each strategy would be applied, as well as additional drawings or renderings when appropriate (IP- E2, K1). Demonstrate there is an active parent-teachers association by providing the article of association and meeting minutes that evidence participation in decision making processes (CSIR, 2015: 65).

Credit synergies

Interview participants considered that these additional credits may also help enrich SoB in schools and may be targeted by project teams that want to reinforce this area (IP-E2, I1):

- Impact of the school design on existing streetscapes (29.1) which includes aspects of safety, security and accessibility, Interior aesthetic quality (31.13) which deals with the school image, Child involvement in afterschool arts and cultural programs (28.4) where the school provides additional services and activities beyond the classroom and the Joint Use of Facilities revised existing LEED credit where spaces are lent to the community.

Cultural Spaces and Events

**31.1. Learning environments and school culture
foster creativity and innovation**

LEED BD+C, O+M: Schools

Innovation in Design category (1 point)

Intent

To promote that arts, technology and entrepreneurial education is included in the curriculum and supporting spaces are designed to facilitate creativity and innovation.

Requirements

For LEED **BD+C** initial certification projects and LEED **O+M**, this pilot credit is available for one (1) point under the Innovation Category. Project teams must comply with the following requirements:

Curriculum integration

Teams are required to evidence the integration of at least two (2) arts, technology and/or entrepreneurship course offerings such as drawing, painting, sculpture, design, music, drama, literature, dance, photography, digital arts, cinematography, and entrepreneurship, among others. A minimum of 68 hours of instruction annually is required ([Amadio et al., 2006: 29](#)).

AND

Building Design: Flexible layout and furniture

A curriculum that fosters innovation should be accompanied by adequate facilities that allow students to create. Also, spaces that promote multiple modalities or dynamics of education (IP-A1). Teams are required to comply with at least two (2) of the following strategies:

- Specify functional and ergonomic furniture for administrative staff, faculty, and students. Children’s furniture must be age-appropriate and selected according to the specific needs of the different programmatic areas (IP-A1). Also, furniture arrangements and layouts, particularly in learning spaces should be flexible enough to encourage students to work collaboratively, allow multiple learning modalities to occur simultaneously and improve the interaction with teachers ([Fielding Nair International, n.d.: 5](#)). Provide adequate storage space.
- Design classrooms for interdisciplinary learning, while providing adequate furniture and equipment. For example, designated classrooms

or studios could be used to teach students science, technology and fine arts concepts (Fielding Nair International, 2010: 22)

- Provide innovation studios, technology center and/or collaborative study areas
- Specify movable wall partitions that allow interconnecting classrooms (IP-A1)
- Showcase student projects in hallways, outdoor courtyards or other designated areas (School E)
- Equip exterior/open spaces for teaching or as learning labs (School D). Provide adequate seating (when necessary) and provide protection from the sun.

This cultural indicator requires that adequate training is provided to school users on how to use, maintain and/or customize the furniture and technologies provided.

Documentation requirements

Inspired by the *School as a Teaching Tool* credit, teams must submit the curriculum; indicate the arts, technology and entrepreneurship courses to be included; and how these were developed; number of instructional hours; an Owner signatory confirming the curriculum meets local and state standards, and will be implemented within 10 months of certification; and written approval from the school's administrative body, including documentation that a policy has been adopted to ensure that the courses will continue to be offered in all future years of the school's certification (USGBC, 2018). Submit an architectural plan that includes the spaces that will be used for arts and innovation courses (IP-E2). Explain the strategies employed to provide flexible spaces, adequate furniture and equipment (IP-I1).

Credit synergies

This indicator relates to the revised *Open Space* credit, in which we recommended adding outdoor lecturing spaces consciously designed for learning and using outdoor areas as exhibition spaces.

Cultural Spaces and Events

Theme on survey: 31.13. Aesthetic Quality of the Building.

Proposed indicator title:

31.13. Interior Aesthetic Quality

(1 point under the Innovation Category: BD+C, O+M)

Intent

The building interiors demonstrate aesthetic value appropriate for its cultural context and function.

Requirements

For LEED **BD+C** initial certification projects and LEED **O+M**, this pilot credit is available for 1 point under the Innovation Category. Project teams must at least comply with one (1) strategy under the Comfort and Image Placemaking category and one (1) of the paths under Sociability and Participation to improve sense of belonging in schools.

Select one (1) out of the following two (2) **Comfort & Image** Placemaking options:

Option 1. Attractiveness

Architectural mechanism elements (Parsaee et al., 2015) including Material and Colour, as well as Proportions and scale, are important tools to achieve attractive interiors:

- Project teams are required to justify their design decisions including scale, proportions, material finishes and colour selection for their projects based on functionality, user well-being, colour psychology, and cultural aspects, among others. Specify materials that are easy to clean, durable and low maintenance considering the limited budget and personnel.
- Incorporate design features and art works by the school community, local artists, among others, adequate for the space and referencing culture (LBC).

OR

Option 2. Quality Views and connection between interior/outdoor spaces

- Prioritize the connection between indoor and outdoor spaces showcasing quality views towards landscapes, artwork pieces or collaborative spaces. Strengthen the human/ nature connection by integrating quality views throughout the project highlighting the natural features of the site. These views can be framed by windows, doors or serve as backdrop to gathering and socialization spaces. Also,

consider effects of natural lighting entering the space. Explain how the project will connect interior/exterior spaces, providing transition spaces or architectural elements, when necessary, that mitigate effects of extreme sunlight and glare.

AND

Select between one (1) of the following two (2) **Sociability and Participation** Placemaking paths emphasizing on community participation for determining the school's aesthetic image:

Path 1. Visual Preference Survey or Focus Group

Project teams are required to administer a survey or convene a focus group during the Predesign or Preliminary design phases. Target population could include a representative group of adjacent property owners, school administrative and maintenance personnel, teachers, parents, and students, as well as local planning and community development officials. It is important to verify local regulations, which may require parent's written consent to involve students in the research. Teams should document and analyse participant's input and modify the project's design as a direct result, or if modifications are not made, explain why community input did not generate any alterations. Also, the indicator requires teams to establish ongoing means for communication with the community throughout the design, construction and operations and maintenance phases. The survey or meeting may be advertised via community associations, institutional email, school bulletin boards, banners and/or the local government.

A list of recommended topics for the survey and meeting was added for participants to choose from and include but are not limited to:

- material and colour selection,
- proportions and scale,
- daylighting,
- art integration,
- views and connection between the interior and exterior,
- comfort of places to sit (furniture selection and layouts)

For example, the Whole Building Design Guide recommends administering a Visual Preference survey in which different architectural images are shown to the community and these are rated on a scale of +10 to -10 in order to identify good design elements (WBDG, 2021). For more information visit: <https://www.wbdg.org/resources/aesthetic-challenges>.

OR

Path 2. Design Review by Expert Panel and/or the School Community

- Designate an independent design review by an expert panel to evaluate the project proposal. Panel members may include architects, interior designers,

contractors, local planning, and community development officials, among others. Professors and students from local architecture and interior design schools could also be involved in the review process (IP-A3).

Documentation requirements

BD+C: Submit a narrative or plan discussing aesthetic issues or opportunities of the project. When involving the community for determining the school's aesthetic image, project teams must submit a copy of the survey instrument, results meet agenda and/or number of participants that attended the meeting and other relevant information. Submit renderings, a concept narrative (IP-B2), as well as material specifications, if applicable depending on the selected strategies.

O+M: Comply with BD+C requirements and also submit an Improvement plan subdivided into phases or stages that incorporates the cultural, aesthetic, design and art elements that will be included on the project. (IP-I1).

Credit synergies

Additional LEED existing credits that might enhance project aesthetics include the following indicators under the Indoor Environmental Quality category:

- [Quality Views](#) for regularly occupied floor areas (BD+C Schools, V4.1)
- [Daylight](#) (BD+C Schools, V4.1): Includes glare control, as well as daylighting measurements and calculations.
- [Interior Lighting](#) (BD+C Schools, V4.1): considers glare control, color rendering, lighting control and surface reflectivity.

Cultural Heritage

Cultural Heritage

Existing Credits with Proposed Addenda

Cultural Heritage

**29.3. Building Life-Cycle Impact Reduction
(Existing LEED credit with proposed addenda)**

LEED BD+C: Schools (v4.1)

Materials and Resources (Possible 5 points)

Current LEED Credit Intent (USGBC, 2022d)

“To encourage adaptive reuse and optimize the environmental performance of products and materials.”

Proposed Addenda:

Location: Intent

Description of Change:

Edit the intent to read as: “To encourage adaptive reuse and optimize the environmental performance of products and materials”. Stimulate design for adaptability to promote increased building longevity and facilitate its future reuse.

Current LEED Requirements (USGBC, 2022d)

Demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment. Achieve one of the following options:

Option 1. Building and Material Reuse (1-5 points BD&C, 2-6 points Core and Shell)

Maintain the existing building structure, envelope, and interior nonstructural elements. Reused or salvaged materials from off site that are incorporated into the building can also contribute to the credit calculations. However, reuse materials contributing toward this credit may not contribute toward MR credit- Sourcing of Raw Materials.

Historic, abandoned or blighted buildings: Portions of buildings deemed structurally unsound or hazardous can be excluded from the credit calculations.

Path 1 and 2 reward projects that reuse structural and/or nonstructural elements based on the project area. Path 1 and 2 can be combined for points.

Proposed Addenda:

Location: Option 1

Description of Change: Add the following requirement: In addition to demonstrating the percentage of structural and/or non-structural elements to be reused by project area in Path 1 and 2, a narrative and/or cost-effectiveness analysis must be included to inform a decision in favour of retention when economic, social, cultural and environmental resources are being saved by reusing portions of the building than demolishing it.

Current LEED Requirements (Cont.) (USGBC, 2022d)

Path 1: Maintain Existing Structural Elements: Walls, Floors, Roofs, and Envelope (1-5 points BD+C, 2-6 points Core & Shell)

Maintain the existing building structure (including floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and nonstructural roofing materials). Calculate reuse of the existing project area according to Table 1.

Table 1. Path 1 Points for reuse of existing building structural elements.

Percent of existing walls, floors and roof reuse by project area	Points BD+C	Points – Core & Shell
15%	1	2
30%	2	3
45%	3	4
60%	4	5
75%	5	6

AND/OR

Path 2: Maintain Interior Non structural Elements (1 point)

Use existing interior nonstructural elements (e.g. interior walls, doors, floor coverings and ceiling systems) for at least 30% of the entire completed building, including additions.

OR

Option 2. Whole-Building Life-Cycle Assessment (1-4 points)

For new construction (buildings or portions of buildings), conduct a cradle-to-grave life-cycle assessment of the project's structure and enclosure and select one or more of the following paths below to earn up to 4 points:

Path 1: Conduct a life cycle assessment of the project's structure and enclosure (1 point).

Path 2: Conduct a life cycle assessment of the project's structure and enclosure that demonstrates a minimum of 5% reduction, compared with a baseline building in at least three of the six impact categories listed below, one of which must be global warming potential (2 points).

Path 3: Conduct a life cycle assessment of the project's structure and enclosure that demonstrates a minimum of 10% reduction, compared with a baseline building, in at least three of the six impact categories listed below, one of which must be global warming potential (3 points).

Path 4: Meet requirements of Path 3 and incorporate reuse and/or salvage materials into the project's structure and enclosure for the proposed design. Demonstrate reductions compared with a baseline building of at least 20% reduction for global warming potential and demonstrate at least 10% reduction in two additional impact categories listed below (4 points).

For Paths 2, 3 and 4 listed above, no impact category assessed as part of the life-cycle assessment may increase by more than 5% compared with the baseline building. Include a narrative of how the life cycle assessment was conducted and if applicable for paths 2, 3 and 4 what changes were made to proposed buildings in order to achieve the related impact reductions.

The baseline and proposed buildings must be of comparable size, function, orientation, and operating energy performance as defined in EA Prerequisite Minimum Energy Performance. The service life of the baseline and proposed buildings must be the same and at least 60 years to fully account for maintenance and replacement. Baseline assumptions must be based on standard design and material selection for the project location and building type. Use the same life-cycle assessment software tools and data sets to evaluate both the baseline building and the proposed building, and report all listed impact categories. Data sets must be compliant with ISO 14044.

Select at least three of the following impact categories for reduction:

- global warming potential (greenhouse gases), in kg CO₂e;
- depletion of the stratospheric ozone layer, in kg CFC-11e;
- acidification of land and water sources, in moles H⁺ or kg SO₂e;
- eutrophication, in kg nitrogen eq or kg phosphate eq;
- formation of tropospheric ozone, in kg NO_x, kg O₃ eq, or kg ethene; and
- depletion of nonrenewable energy resources, in MJ using CML / depletion of fossil fuels in TRACI.

Proposed Addenda:

Location: Option 3

Description of Change: Added a third option that reads as follows:

OR

Option 3. Design for Adaptability (1-5 points)

This option focuses on designing schools that are easy to readapt for future reuse and needs because the building systems are flexible. Project teams must demonstrate compliance with up to five (5) of the following strategies, each worth one (1) point. These are based on guidelines by the American Society of Testing and Materials (ASTM, 2020a, 2020b, 2019), Saleh and Chini (2009: 33) and interview participant recommendations:

- Design luminaries, air diffusers and exhaust air ducts for easy relocation or removal
- Design data and electrical systems with spare capacity and easy access
- Design for easy relocation or removal of partition walls
- Select a structural system that allows spaces to be easily reconfigured
- Provide access pathways for changes to building utilities and infrastructure
- Adopt “open-space” concepts where possible and design multiuse spaces that can be easily adapted depending on the program or activity (IP-K1)
- Specify movable room dividers for classrooms, that can be opened or closed when needed (IP-A3)

Documentation requirements include the submission of a list of strategies that will be employed to promote the building’s adaptability. Also, teams must provide the plans and detailed specifications of relevant building components and materials that demonstrate their expected service life.

Credit synergies

Buildings might be easier to modify to fulfil future needs when designed with adaptability. Unutilized school spaces could be lent or rented to community organizations or for other compatible uses favouring compliance with the *Joint-Use of Facilities* (31.6) credit requirements.

Cultural Heritage

**29.4. School as a Teaching Tool
(Existing LEED credit with proposed addenda)**

LEED BD+C: New Construction; O+M: Existing
Buildings (v4.1)
Innovation Catalog (1 point)

Current LEED Credit Intent (USGBC, 2018)

“Integrate the sustainable features of a school facility with the school’s educational mission.”

Proposed Addenda:

Location: Intent

Description of Change: Revise the intent to read as:

“Integrate the sustainable and cultural features of a school facility with the school’s educational mission.” Educate the school community regarding the cultural sustainability strategies implemented.

Current LEED Requirements (USGBC, 2018)

Provide school staff with the knowledge to identify what supports or impedes healthy, resource-efficient and environmentally sustainable learning spaces; and the foundation for imparting that knowledge to their students. Additionally, educate students on the connections between the built and natural environment; and the knowledge, skills, and behaviors to recognize and apply that learning in their own school facility.

Proposed Addenda:

Location: LEED Requirements

Description of Change: Revise the paragraph to read as follows:

Provide school staff with the knowledge to identify what supports or impedes healthy, resource-efficient, culturally, and environmentally sustainable learning spaces; and the foundation for imparting that knowledge to their students. Additionally, educate students on the connections between the built and natural environment; and the knowledge, skills, and behaviors to recognize and apply that learning in their own school facility. Also, cultural considerations that may include,

but are not limited to, how buildings impact culture and the cultural expression of values and beliefs through building design.

Current LEED Documentation Requirements- Teacher Training (USGBC, 2018)

Provide required documentation of teacher training and educating students from the below options:

[Option 1] For **training teachers**, *either* Provide access to the Green Classroom Professional Certificate program to all full-time school staff and ensure at least 50% pass the exam. The education portion of the Green Classroom Professional (GCP) may be delivered through the self-paced online modules, or by an in-person workshop led by a member of the design team, local USGBC community or school leader, utilizing GCP training materials found at <http://www.usgbc.org/classroom/gcp>. The assessment portion of the GCP should be completed via the online exam. Submit a roster of full-time school staff. Provide documentation that a policy has been adopted to ensure that, for all future years of the school's certification, at least 50% of school staff have successfully passed the GCP exam.

OR

[Option 2] Provide at least 50% of full-time school staff with training on the primary elements of green schools, including knowledge about what supports or impedes healthy, resource-efficient and environmentally sustainable learning spaces. The training should be designed by a professional with working knowledge of green building principles and the strategies that were incorporated into the school's LEED project. Administer a written assessment of learning at the conclusion of training with every training attendee. After completing the training, participants should be able to identify the ways in which classroom professionals can:

- Support the health of school occupants, including teachers, students and staff
- Provide the best physical environment possible for student academic performance
- Decrease absenteeism due to environmental factors
- Support environmentally responsible practices by saving energy, saving water and improving indoor environmental quality
- Foster an appreciation among future generations for environmentally sustainable practices
- Become part of the green schools and green building communities
- Apply for elective continuing education credits to maintain a teaching credential

Submit a description of the training that includes syllabus, a copy of materials (digital or print) provided to school staff including the assessment, credentials of the instructor(s); and a roster of full-time school staff, including the individuals who completed training and those who passed the assessment. Provide

documentation that a policy has been adopted to ensure that, for all future years of the school's certification, at least 50% of school staff complete training and pass the assessment.

Proposed Addenda:

Location: Documentation Requirements > Teacher training > Option 2

Description of Change: Revise the paragraph to read as follows:

[Option 2] Provide at least 50% of full-time school staff with training on the primary elements of green schools, including knowledge about what supports or impedes healthy, resource-efficient, culturally and environmentally sustainable learning spaces. Also, cultural considerations that may include, but are not limited to, how buildings impact culture and the cultural expression of values and beliefs through building design. The training should be designed by a professional with working knowledge of green building principles and the cultural strategies that were incorporated into the school's LEED project. [...]

Location: Documentation Requirements/ Teacher training

Description of Change: Modify/ add the following bullet points focusing on cultural sustainability:

"After completing the training, participants should be able to identify the ways in which classroom professionals can":

- Create awareness of the impact of green buildings on user's sustainable culture
- Foster an appreciation among future generations for environmentally sustainable practices, strategies, cultural design features and heritage

Current LEED Documentation Requirements (Cont.- Student Training) (USGBC, 2018)

AND

[Option 1] For educating **students**, *either* provide annually a subscription to the K-12 Learning Lab (www.learninglab.usgbc.org) for at least 25% of all full-time educators at the school, ensuring that at least one educator per grade has access to the annual subscription. Within 10 months of LEED certification and for every subsequent year of certification, provide 10 or more hours of classroom instruction per year per full-time student from the [Foundations of Green Building](#) section of Learning Lab, which contains curricular materials related to the built environment. Submit a simple implementation plan that includes the strategy for meeting the 10 hours-per-student requirement; a roster of full-time school staff, including individuals for whom a subscription to Learning Lab has been provided; and written approval from the school's administrative body, including documentation that a policy has been adopted to ensure that, for all future years of the school's certification, at least 25% of teaching staff have access to the Learning Lab subscription and are delivering at least 10 hours of instruction per student per year.

OR

[Option 2] Design curriculum based on the high-performance features of the building, and commit to implementing the curriculum within 10 months of LEED certification. The curriculum should not just describe the features themselves but explore the relationship between human ecology, natural ecology and the building ecology of the building. Curriculum must meet local or state curriculum standards, be approved by school administrators, and provide 10 or more hours of classroom instruction per year per full-time student. Submit a narrative describing the content of the curriculum and how it was created; an Owner signatory confirming the curriculum meets local and state standards, provides 10 hours of instruction per student per year, and will be implemented within 10 months of certification; and written approval from the school's administrative body, including documentation that a policy has been adopted to ensure that, for all future years of the school's certification, the school provides at least 10 hours of instruction per student per year from the approved curriculum.

Proposed Addenda:

Location: Option 2

Description of Change: Revise the text as follows:

Design a curriculum based on the high-performance and cultural features of the building, and commit to implementing the curriculum within 10 months of LEED certification and revise yearly. The curriculum should not just describe the features

themselves but explore the relationship between human ecology, natural ecology and the building ecology of the building. Furthermore, showcase the cultural features of the building and develop educational activities that discuss how they relate to the local history, traditions, or customs. Also, explore how sustainable features of the building such as water saving strategies, recycling, among others can impact both the individual and collective school culture.

Location: Option 3 (new)

Description of Change: Added a third option, aligned with the Sociability and Participation Placemaking strategy which aims to promote school and community relations. This option was inspired by the LEED *Green Building Education* credit (USGBC, 2022d). The text would read as follows:

Option 3: Select two (2) out of the following three (3) paths to showcase the cultural sustainability building features and promote integration school and community relations:

- Path 1. Include signage to showcase the building's cultural sustainability features and educate its occupants and visitors.
- Path 2. Develop a brochure, manual, guideline, website, electronic newsletter and/or case study to inform the design of other sustainable schools
- Path 3. Develop and implement an educational outreach program, exhibition, or school guided tour

Project teams can propose one (1) alternate educational strategy for consideration by the USGBC evaluation team. However, a second strategy must be selected from the above list.

Submit a narrative explaining the initiatives to be implemented and how the school design relates to the culture of the location (IP-I1). Include plans that indicate the specific location of signage or informative stations; images, renderings, electronic documents, and/or photographs with the proposed design. Include a copy of the information to be included in the graphics (IP-B2) and indicate how frequently information will be updated and by whom. For historic buildings, submit an extract from the heritage register to demonstrate the building's cultural value (Green Building Council Australia, 2015).

Cultural Heritage

Proposed Pilot Credits

Cultural Heritage

Theme on survey: 29.1. Impact of the school design on existing streetscapes (iiSBE, 2009)

Proposed indicator title:

29.1. Impact of the school design on the existing townscape or landscape

LEED BD+C: Schools

Proposed for the Innovation in Design Category (1 point)

Intent

To promote the preservation or improvement of the existing landscape or townscape by ensuring that the proposed building's street presence is appropriate for the local context.

Requirements

For LEED **BD+C** initial certification projects, this pilot credit is available for 1 point under the Innovation Category. Project teams must select at least one (1) of the Access and Linkages, Comfort and Image, and Sociability and Participation options and comply with one (1) path under each. Teams must select the Paths depending on the project's applicability.

Select one (1) of the available options and comply with at least one (1) path under the **Access and linkages** Placemaking category:

Option 1. Access to quality transit

If the school site is located in a residential, rural or town context with limited or narrow streets, avoid causing unnecessary traffic congestion during peak times. Analyze local traffic in the area and incorporate strategies to improve or avoid affecting current patterns. Strategies may include:

- Path 1. Developing a marginal access street parallel and adjacent to existing streets to provide protection for parents and students during drop off/ pick up times (IP-K2). OR
- Path 2. The school common areas or shared community spaces should be accessible, attractive, and inviting. Demonstrate the availability of alternative transportation (see the Alternative Transportation credit requirements) (USGBC, 2022e), parking, among other strategies that facilitate access to the school community and visitors, during and after school hours (IP-K2). OR

- Path 3. When applicable and where zoning ordinances permit, the building may be setback from the sidewalk to improve the pedestrian and vehicular experience, as well as the perception of the street from the outside and inside the building ([Auckland Design Manual, 2022, IP-K2](#)).

Option 2. Street presence

A building’s architectural presence may be defined as the degree of visibility which is appropriate or desired for a specific context and design (Dept. of Planning and Development, 2013). A site or building may hold a “high-profile” design with an individual identity, or may hold a simpler design that contributes to the block as a whole (Dept. of Planning and Development, 2013). The following strategies may contribute to street presence:

- Path 1: Inviting entrance: Include a “welcoming” and clearly marked entrance (Arup, 2012). In tropical climates, the integration between interior and exterior areas could be an overarching theme throughout the design that starts at the entrance (IP-E2). The openness of the entrance design is inviting to visitors (IP-E2). Encourage all building facades to incorporate design detail, articulation and quality materials (Dept. of Planning and Development, 2013). OR
- Path 2: Drop off: Include an area protected from the sun and rain for parents to drop off and pick up their children (Fielding Nair International, 2010b: 58). OR
- Path 3: Provide a signature or identity element that may be associated with the school’s theme (technology, science, music, art) (Fielding Nair International, 2010b: 58). Also, provide adequate school signage.

Select one (1) of the available options and comply with at least one (1) path under the **Comfort & Image** Placemaking category:

Option 1. Comfort and Image

- Path 1. The building scale and proportions, identified as architectural mechanism (Parsaee et al., 2015), are an important tool that contributes to street presence and overall building attractiveness. Project teams are required to justify the building’s scale, and massing and explain their relationship to the urban, rural, or natural surroundings.
- Path 2. Teams are required to retain vistas on the site and respect adjacent property vistas ([UIA, 2012](#)).

Option 2. Feeling of safety and security

Ensuring a safe and secure environment is a growing challenge for schools, considering theft, vandalism, robberies and assaults as some of the problems. To target these issues, project teams are encouraged to:

- Path 1. Promote strategies that make students feel less attracted to doing vandalism and strengthen the sense of belonging. If students feel that the school is theirs, they might feel less inclined to damage it (IP-J1). For example, designate an expression wall or other medium for students to express themselves. Also, find

ways to involve students and personnel in green cleaning practices (Healthy Schools Campaign, 2015). AND/OR

- Path 2. Employ design strategies adequate for the local context, so that the architecture itself provides users with the necessary security (School B). AND/OR
- Path 3. Design spaces with high levels of natural surveillance (Arup, 2012). This concept entails the placement of physical features in a position that maximizes the ability to see what is occurring in a given space, and optimize the potential to detect suspicious activities (City of Red Deer, 2022).

Select between one (1) of the following two (2) **Sociability and Participation** Placemaking paths emphasizing on **community participation for determining the school's street presence**:

Path 1. Visual Preference Survey or Focus Group

Project teams are required to administer a survey or convene a focus group during the Predesign or Preliminary design phases. Target population could include a representative group of adjacent property owners, school administrative and maintenance personnel, teachers, parents, and students, as well as local planning and community development officials. It is important to verify local regulations, which may require parent's written consent to involve students in the research. Teams should document and analyse participant's input and modify the project's design as a direct result, or if modifications are not made, explain why community input did not generate any alterations. Also, the indicator requires teams to establish ongoing means for communication with the community throughout the design, construction and operations and maintenance phases. The survey or meeting may be advertised via community associations, institutional email, school bulletin boards, banners and/or the local government.

A list of recommended topics for the survey and meeting was added for participants to choose from and include but are not limited to:

- façade design, material and colour selection,
- proportions and scale,
- signature or identity element associated with the school's theme,
- views and connection between the interior and exterior,
- feeling of safety and security

For example, the Whole Building Design Guide recommends administering a Visual Preference survey in which different architectural images are shown to the community and these are rated on a scale of +10 to -10 in order to identify good design elements (WBDG, 2021). For more information visit: <https://www.wbdg.org/resources/aesthetic-challenges>.

OR

Path 2. Design Review by Expert Panel and/or the School Community

- Designate an independent design review by an expert panel to evaluate the project proposal. Panel members may include architects, interior designers, contractors, local planning, and community development officials, among others. Professors and students from local architecture and interior design schools could also be involved in the review process (IP-A3).

Documentation requirements

Project teams are required to provide a narrative or list of proposed strategies and explain how the project team will implement them, while also including a budget and timeframe. Teams should include plans and renderings indicating where they would apply each strategy (IP-B2, I1). In the narrative, participants should reference relevant codes, ordinances and/or land use plans and demonstrate compliance (IP-A3). When involving the community for determining the school's street presence, project teams must submit a copy of the survey instrument, results meet agenda and/or number of participants that attended the meeting and other relevant information.

Cultural Education

Cultural Education

Proposed Pilot Credits

Education

28.4. Child involvement in afterschool arts and cultural programs

LEED BD+C, O+M: Schools (v4.1)

Innovation category (1 point)

Intent

Promote community participation in afterschool arts and cultural programs.

Requirements

For LEED **BD+C** and **O+M** certification projects, this pilot credit is available for 1 point under the Innovation Category. Project teams must comply with the requirements specified in each of the three (3) Placemaking categories: Sociability and Participation, Design, and Uses and Activities.

Sociability and Participation

Design an afterschool arts and cultural program that may include training in culture, multilingual education, arts, sports and creative fields, among others. Comply with at least two (2) of the following strategies:

- Encourage older students to participate as teaching assistants or tutors for smaller children.
- Promote participation from members of the internal and external school community.
- In collaboration with the school authorities, contract with non-profit, cultural institutions, community or other organizations to provide at least two types of activities per week as part of the afterschool programs (USGBC, 2022b).

AND

Design of context specific academic programming

Afterschool offerings should relate to at least one (1) of the following:

- academic programs in the school and/or
- building's cultural sustainability features and/or
- teach students and the community about trades or other topics related to the cultural or socio-economic activities of the area

AND

Uses and activities

Adequate spaces must be provided for after-hours programming. The spaces provided for the *Joint Use of Facilities* credit could also be employed for afterschool experiences: auditorium; gymnasium; cafeteria; classrooms; playing fields and stadiums; library; computer labs; open-air amphitheatre, exhibition areas, as well as open courtyards or semi-enclosed areas within them. Spaces with independent and separate entrance/ exits, access to restrooms and the parking lot are recommended.

Documentation requirements

Inspired by the *School as a Teaching Tool* credit, teams must submit the curriculum and a narrative describing the afterschool programming and how it was created; budget and personnel required (IP-K1), an Owner signatory confirming the curriculum meets local and state standards, provides 10 or more hours of afterschool programming per week, and will be implemented within 10 months of certification; and written approval from the school's administrative body, including documentation that a policy has been adopted to ensure that, the afterschool programming will continue in all future years of the school's certification (USGBC, 2018). Also describe how the program will be advertised (IP-A3). Submit an architectural plan that includes the spaces that will be used for afterschool programming (IP-I1).

In addition to the above requirements, teams applying for O+M, must indicate the number of children and teachers involved in afterschool programs, as well as the number of courses or activities per period (Rosario Jackson et al., 2006).

Credit synergies:

Strategies in this credit may also be used to earn points in the following credits:

- The School as a Teaching Tool
- Joint Use of Facilities

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Glossary

Culture: For the purpose of this study, culture is defined as the characteristics of a society, its norms, values, skills, knowledge, beliefs and aspirations that serve as a guide for an individual or group to construct regional identities (Axelsson et al., 2013:217; Dessein et al., 2015:xiv; Hawkes, 2001:3; Walker, 2014:6). It can manifest itself through intellectual or artistic creativity, while individuals, organizations or institutions are responsible for its dissemination (UNESCO, 2001). Culture could also be interpreted as “way of life”, including its “customs, faith and conventions, codes of manners, dress, cuisines, language, arts, science, technology, religion, rituals, regulations of behaviour and traditions” (Hawkes, 2001:3).

Cultural vitality in places: Emphasizes on the distinctive identities and sense of place that generate opportunities (spaces and activities) for cultural participation, social interactions and economic development (Zakariya and et. al.'s 2016:229). This definition is aligned with LEED's IC but, in addition, includes the concept of identity in juxtaposition to SoP, as an essential component or prerequisite to achieve cultural vitality. Recognizing the school's identity and sense of place will help to determine its uniqueness and significance (Zakariya and et. al.: 2016). We propose the following equation to summarize this concept:

Cultural vitality= identity + cultural spaces with a strong sense of place

Cultural Heritage: Cultural heritage includes the “legacy which we receive from the past, which we live in the present and which we will pass on to future generations”(UNESCO, 2020). Spaces may also house intangible expressions including performances, arts, rituals, festive events, and crafts, among others, that have the potential to promote a sense of individual and collective sense of belonging (UNESCO, 2020).

Appendices

Appendix 1

Surrounding Density and Diverse Uses LEED BD+C: Schools (v4.1)

The following table is referenced in the LEED credit *Surrounding Density and Diverse Uses*, Option 2.

Table 1. Use Types and Categories

Category	Use type
Food retail	Supermarket
	Grocery with produce section
	Convenience store
Community-serving retail	Farmers market
	Hardware store
	Pharmacy
	Other retail
Services	Bank
	Family entertainment venue (e.g., theater, sports)
	Gym, health club, exercise studio
	Hair care
	Laundry, dry cleaner
Civic and community facilities	Restaurant, café, diner (excluding those with only drive-thru service)
	Adult or senior care (licensed)
	Child care (licensed)
	Community or recreation center

Cultural arts facility (museum, performing arts)

Education facility (e.g., K—12 school, university, adult education center, vocational school, community college)

Government office that serves public on-site

Medical clinic or office that treats patients

Place of worship

Police or fire station

Post office

Public library

Public park

Social services center

Community anchor uses
(BD&C and ID&C only)

Commercial office (100 or more full-time equivalent jobs)

Housing (100 or more dwelling units)

Adapted from Criterion Planners, INDEX neighborhood completeness indicator, 2005.

Source: (USGBC, 2022c)

Appendix 2: Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits

KEY: Placemaking (PM) Categories

AL: Access & Linkages

SP: Sociability & Participation

UA: Uses & Activities

CI: Comfort & Image

D: Design

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits									
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted				
		Intent	Requirements	Documentation Req.					
Cultural Spaces and Events									
31.5. Open Space	E	Edit the intent to read as: "To create exterior space <u>compatible with local cultural values and practices</u> that encourages interaction with the environment, <u>socio-cultural exchange</u> , passive	<ul style="list-style-type: none"> • Provide social area adequate for outdoor socio-cultural activities • Added list of Placemaking (PM) strategies including creating outdoor spaces that are: <ul style="list-style-type: none"> • Context specific • Accessible • Collaborative 	Added the following requirements: <ul style="list-style-type: none"> • Narrative and supporting documentation that describes how the space is compatible with local cultural values and practices. 	A	S	U		D

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits									
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted				
		Intent	Requirements	Documentation Req.					
		recreation, and physical activities.”	<ul style="list-style-type: none"> Consciously designed for learning 	<ul style="list-style-type: none"> Submit evidence of participatory design strategies 					
31.6. Joint Use of Facilities	E	Add the following sentence to the intent: <u>“Encourage user participation and socio-cultural exchange through the provision of spaces and programming strategies.”</u>	Rev. to Option 1: <ul style="list-style-type: none"> Included additional spaces that may be lent to the community, including: library; computer labs; open-air amphitheatre, exhibition areas, and open courtyards. Accessible spaces follow barrier-free or universal 	BD+C: In addition to current req., submit evidence of community consultation processes. Submit a plan or narrative that explains (1) how the building will be secured and how personal security will be provided to users; (2) recurring	A L	S P	U A	C I	D

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits						
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted	
		Intent	Requirements	Documentation Req.		
			design guidelines. <ul style="list-style-type: none"> • Provision of independent access to community spaces while providing security for the rest of the school. • Development of a community program to promote the use and maintenance of share spaces. Rev. to Option 2: <ul style="list-style-type: none"> • Provision of independent access to 	maintenance strategies; (3) advertising and activities plan; (4) training plan for school directors and supporting personnel. Credit reactivation for O+M: Submit the proposed activities plan and/or (2) evidence of the relationship between the use of these spaces and the school's curriculum; teaching plans		

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits						
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted	
		Intent	Requirements	Documentation Req.		
			community spaces Rev. to Option 3: <ul style="list-style-type: none"> Provision of pedestrian access from the school, alternate means of transport and/ or parking New Option 4: <ul style="list-style-type: none"> Sign a co-management agreement between the school and other organizations . Provide an administrative office with storage 	and/or course syllabi.		

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
31.14. Surrounding Density & Diverse Uses	E	Added: "To support neighborhood and local economies, <u>access to cultural experiences</u> , promote walkability, and low or no carbon transportation, and reduce vehicle distance traveled for all."	Rev. to Option 2: Added the following PM requirements: Sociability and Participation: <ul style="list-style-type: none"> Cultural amenities nearby complement existing school resources and provide activities for students that are integrated with the curriculum. Access and Linkages:	<ul style="list-style-type: none"> Provide a narrative explaining the link between neighboring spaces and school activities. Proposed curriculum, Site plan Provide signed joint-use agreements 	A	S	L	P

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			<ul style="list-style-type: none"> Availability of pedestrian access and/or public transport 					
31.4. Provide a Space for Communal Meals	N	Provide a space for communal meals where occupants can sit for meals, gather, and socialize.	<p>Demonstrate compliance with one (1) of the following PM categories:</p> <p>Option 1: Uses and activities: Extension of the school canteen seating areas to adjacent exterior and/ or semi-covered areas</p> <p>Option 2: Design for Adaptability: Design a multifunctional space with flexible and</p>	<p>Option 1: Submit narrative explaining how the school canteen relates to these supporting spaces. Provide a plan marking up the communal space and a furniture layout</p> <p>Option 2: Provide a floorplan, furniture layout, specifications and</p>		S P	U A	D

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits						
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted	
		Intent	Requirements	Documentation Req.		
			window to facilitate food and supplies pickup during emergencies and disaster recovery.	vehicular access route.		
31.9. School Community Sense of Belonging	N	Strengthen the user's Sense of Place and Belonging by providing opportunities, projects and spaces that promote school community ownership and participation in decision making processes.	<p>Comply with the Community participation in decision making processes requirement: Schools are required to have an active community/ parent/ teacher's association or equivalent.</p> <p>AND Comply with at least one (1) of the SP PM paths:</p>	<ul style="list-style-type: none"> Submit a plan that includes historical, cultural, ecological, and climatic studies that examine the project site and context and evidences community/ parent/ teacher participatory processes. 	S	P

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			<p>Path 1: Develop projects and spaces that the school community can take ownership of.</p> <p>OR</p> <p>Path 2: Display elements of community ownership</p>	<ul style="list-style-type: none"> Narrative with a list of strategies, as well as an implementation plan. Site plan or floorplan Evidence of an active parent-teachers association 				
31.11. Learning Environments and School Culture Foster Creativity and Innovation	N	To promote that arts, technology and entrepreneurial education is included in the curriculum and supporting spaces are designed to facilitate creativity and	<p>Curriculum integration of at least two (2) arts, technology and/or entrepreneurship course offerings</p> <p>AND</p> <p>Building Design: Flexible layout and furniture that promotes</p>	Submit the curriculum; narrative; written approval from the school's administrative body to ensure that the courses will continue to be offered in future				D

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits							
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted		
		Intent	Requirements	Documentation Req.			
		innovation.	multiple modalities or dynamics of education	years; Owner signatory confirming the curriculum meets local and state standards, and will be implemented within 10 months of certification; architectural plan			
31.13. Interior Aesthetic Quality	N	The building interiors demonstrate aesthetic value appropriate for its cultural context and function.	Select one (1) out of the following two (2) CI PM options: Option 1. Attractiveness: • Justify design decisions. Specify materials that are easy to clean, durable and low maintenance	BD+C: Submit a narrative or plan discussing aesthetic issues or opportunities of the project. Evidence of community consultation processes.		S P	C I

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			considering the limited budget and personnel. <ul style="list-style-type: none"> Incorporate design features and art works Option 2. Quality Views and connection between interior/outdoor spaces <ul style="list-style-type: none"> Showcase quality views towards landscapes, artwork pieces or collaborative spaces. AND Select between one (1) of the	Submit renderings, narrative, as well as material specifications, if applicable. O+M: comply with BD+C requirements and submit an Improvement plan				

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits							
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted		
		Intent	Requirements	Documentation Req.			
			following two (2) SP PM paths: Path 1. Visual Preference Survey or Focus Group OR Path 2. Design Review by Expert Panel and/or the School Community				
Cultural Heritage							
29.3. Building Life-Cycle Impact Reduction	E	Add sentence to the intent: <u>Stimulate design for adaptability to promote increased building longevity and facilitate its future reuse.</u>	Rev. to Options 1&2: In addition to demonstrating the percentage of structural and/or non-structural elements to be reused, a narrative and/or cost-effectiveness analysis	Submission of a list of strategies that will be employed to promote the building's adaptability. Provide the plans and specifications			D

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits							
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted		
		Intent	Requirements	Documentation Req.			
			<p>must be included OR</p> <p>New Option 3: Design for Adaptability</p> <p>Design schools with flexible building systems that are easy to readapt for future reuse</p>				
29.4. School as a Teaching Tool	E	<p>Add sentence to the intent: <u>Educate the school community regarding the cultural sustainability strategies implemented.</u></p>	<p>Rev. to Options 1 & 2:</p> <p>In addition to teaching students and teacher about environmental considerations, the credit is expanded to encompass cultural considerations.</p>	<p>Req. added for Option 3:</p> <ul style="list-style-type: none"> Narrative; plans; images, renderings, electronic documents, and/or photographs Historic buildings: 		S	P

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			<p>Added new Option 3, aligned with the SP PM strategy: Select two (2) out of the following three (3) paths to showcase the cultural sustainability building features and promote integration school and community relations: Path 1. Include signage to showcase the building's cultural sustainability features</p>	<p>submit an extract from the heritage register to demonstrate the building's cultural value</p>				

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			<ul style="list-style-type: none"> • Path 2. Develop a brochure, manual, guideline, website, electronic newsletter and/or case study • Path 3. Develop and implement an educational outreach program, exhibition, or school guided tour. Alternate paths may be submitted to the USGBC for approval. 					
29.1. Impact of the School Design on the Existing Townscape or Landscape	N	To promote the preservation or	Select at least one (1) of the	• Narrative or list of	A	S		C
					L	P		I

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits

Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted				
		Intent	Requirements	Documentation Req.					
		improvement of the existing landscape or townscape by ensuring that the proposed building's street presence is appropriate for the local context.	AL, CI, and SP Options and comply with one (1) path under each: Access and linkages: Option 1: Access to quality transit Analyze local traffic and incorporate strategies to improve or avoid affecting current patterns. Path 1. Develop a marginal access street Path 2. Demonstrate the availability of alternative transportation,	proposed strategies and explain how these will be implemented, budget and timeframe. <ul style="list-style-type: none"> Plans and renderings. Evidence of community consultation processes 					

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits

Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			and parking. Path 3. Building may be setback from the sidewalk to improve the pedestrian and vehicular experience Option 2. Street presence Path 1. Inviting entrance Path 2. Drop off Path 3. Provide identity element associated with the school's theme. Comfort & Image Option 1: Path 1. Justify the					

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits						
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted	
		Intent	Requirements	Documentation Req.		
			building's scale, and massing. Path 2. Respect an retain significant vistas on the site Option 2. Feeling of safety and security Path 1. Promote strategies that make students feel less attracted to doing vandalism and strengthen the sense of belonging Path 2. The architecture itself provides users with the necessary security			

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			Path 3. Design spaces with high levels of natural surveillance Sociability and Participation Path 1. Visual Preference Survey or Focus Group Path 2. Design Review by Expert Panel and/or the School Community					
Cultural Education								
28.4. Child Involvement in Afterschool Arts and Cultural Programs	N	Promote community participation in afterschool arts and cultural programs.	Comply with the requirements in each of the three (3) PM categories SP, D, and UA: SP: Design an afterschool arts	BD+C: Submit the curriculum; narrative; written approval from the school's administrative body to		S	U	D
						P	A	

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits								
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted			
		Intent	Requirements	Documentation Req.				
			and cultural program. AND Design of context specific academic programming AND Uses and activities: Adequate spaces must be provided for after-hours programming	ensure that the courses will continue to be offered in future years; Owner signatory confirming the curriculum meets local and state standards, and will be implemented within 10 months of certification; architectural plan O+M: comply with BD+C requirements and indicate the number of children and teachers				

Summary of Proposed LEED Pilot Credits and Revisions to Existing Credits						
Indicators	New (N) or Existing (E) Credit	Proposed Changes			Placemaking Categories Targeted	
		Intent	Requirements	Documentation Req.		
				involved in afterschool programs; number of courses or activities per period		
KEY: Placemaking (PM) Categories AL: Access and Linkages SP: Sociability and Participation UA: Uses and Activities CI: Comfort and Image D: Design						

APPENDIX Y: TABLE SUMMARIZING RESEARCH OBJECTIVES, KEY ISSUES FOUND, PROPOSED CHANGES AND RECOMMENDATIONS

RQ: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context?		
Research Objectives/ Key issues	Proposed changes/ Findings	Justification
<p>Determine if LEED addresses social and cultural elements as sustainability indicators (R01)</p>	<p>LEED criteria focus mainly on targeting the environmental dimension of sustainability. Identified the need to further develop cultural aspects, which are overlooked worldwide.</p> <p>While early stages of the research explored both social and cultural dimensions, later decided to focus only on the cultural one which is less developed in LEED.</p>	<p>Cultural sustainability may inform which practices need to be modified and those that should be retained by a society for future generations to come (University of Helsinki, Climate University and Una Europa, 2022). Therefore, the inclusion of culture in sustainability has been given significant importance worldwide by organizations such as UNESCO, as evidenced in the 2030 Sustainable Development Goals (2019).</p> <p>Many of the proposed pilot indicators promote the development of culturally adequate buildings to strengthen user “sense of belonging” which could help promote individuals’ pro-environmental behaviours and involvement in the building’s planning, design, operations and maintenance phases.</p>
<p>Analyse how LEED indicators and regionalization initiatives can be modified to respond more effectively to the tropical context of P.R. (R02)</p>	<p>Cultural credits could not be selected as regional priorities because these were not included in LEED.</p> <p>Pilot Credits (PC) within LEED’s Innovation in Design Category could be used to test the proposed cultural indicators product from this research, in order to adapt the system to the</p>	<p>Once approved by the USGBC and tested as PC, a Socio-cultural Working Group, could be organized by the USGBC to further develop these indicators. Once these credits are integrated into LEED, Green Building Chapters could recognize cultural credits as critical and</p>

RQ: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context?		
Research Objectives/ Key issues	Proposed changes/ Findings	Justification
	local context and improve its effectiveness in measuring sustainability in P.R.	select them as Regional Priorities.
Identify sustainability aspects that could be incorporated as indicators (RO3)	<p>This research identified the strategies design and construction professionals employed to comply with LEED but also to ensure that the local identity is preserved. One example would be the use of passive design strategies adequate for the local climate, even though these are not expressly rewarded in LEED.</p> <p>Additionally, the survey and interviews to design and construction professionals pointed to a total of 13 indicators considered important for local schools to be further developed as Pilot Credits.</p>	Credit selection was based on analysis from SAS worldwide but also from a cultural assessment of schools in P.R. that allowed for the development of culturally specific credits.
Develop a methodology or framework to assess and evaluate applicable sustainability criteria that could be incorporated into the LEED SAS. (RO4)	<ul style="list-style-type: none"> • International Comparison of Indicators in SAS: Facilitates the development of additional credits under any of the sustainability dimensions and could be a valuable tool to evaluate existing SAS. • The research instruments developed (survey and interview questions) served as tool to build a cultural profile of schools in P.R. and understand design and construction professional's intention. • Implemented Action Research strategies and strong consultation 	<p>There was a need to develop a methodology and research instruments to develop LEED indicators but that could also be a contribution to knowledge, and be employed for further research and by other researchers.</p> <p>This research employed several strategies to determine the credibility or validity of its findings such as triangulation and respondent validation. In the triangulation design, both quantitative and qualitative data was collected and analysed to determine convergence, differences, or both. This</p>

RQ: What credits should be added, modified or substituted to develop a revised LEED model for its specific socio-cultural context?		
Research Objectives/ Key issues	Proposed changes/ Findings	Justification
	<p>processes to propose an agenda for reform to develop indicators to improve cultural vitality in LEED. The inclusion of design and construction professionals in the Pilot Credit (PC) development processes ensures that the proposed modifications are relevant for the local context and meet user needs.</p> <p>Promote collaboration between the researcher and participants, who may benefit from the end result.</p>	<p>served to confirm and corroborate the research findings obtained in the survey and interviews.</p>
<p>Propose modifications to existing LEED credits and new cultural sustainability indicators adapted for the local context (R05)</p>	<ul style="list-style-type: none"> • The LEED Cultural Sustainability Credit Guide (Appendix X), resulting from this thesis will facilitate the dissemination process amongst LEED users and the USGBC, while providing professionals with the necessary information to submit the PC's. A total of eleven (11) indicators are included in this guide. • Inclusion of Placemaking strategies into LEED credit requirements 	<p>One of the main contributions to knowledge of this research is that it provides a tangible by-product that will facilitate the dissemination process amongst LEED users and the USGBC.</p> <p>The inclusion of PM strategies promotes the inclusion of the user in the making of their own culture, while strengthening sense of belonging.</p>