THE TRAJECTORY OF DESIGN SKETCHING: AN INQUIRY INTO EDUCATIONAL PATHWAYS, HIGHER EDUCATION TRANSITIONS & DESIGN SKETCHING SYLLABUS DEVELOPMENT FOR 1ST YEAR PRODUCT DESIGN STUDENTS

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ABSTRACT
The transition from secondary education to higher education (HE) for students pursuing a Product Design (PD) course is fraught with challenges. It is commonplace for first year PD students to face various difficulties, with one of the most common being attempting to understanding/apply design sketching techniques. Most students find the transition from secondary education hard due to having to either unlearn bad habits or overcome poor tuition or guidance given to start learning good design sketching process in the form of perspective, proportion, and composition. Students are also quickly transitioning to digital sketching solutions and AI platforms without grasping the fundamentals of design sketching first. The understanding and implementation of the foundations of core design sketching skills is a critical aspect to grasp at the start of the HE journey within the PD curriculum. This paper seeks to discuss the design sketching background of students entering HE and their transition from secondary education. We present a student survey completed by sixty-seven students across BA/BSc Product Design FT/SW at Nottingham Trent University (NTU) which identifies the student perceived skill set before and after their first-year studies. This paper discusses the implementation of a 1st year design sketching syllabus aimed at upskilling students in the fundamentals of traditional design sketching tools/communication, thus providing a platform to explore digital/immersive technologies in the future. The hurdles faced when trying to implement a seamless transition from secondary education to HE are identified whilst attempting to further understand the needs/wants of PD students. Recommendations made in this paper will help inform PD educators on design sketching syllabus design.

Keywords: Design sketching, design education, higher education transitioning, product design, secondary education

1   INTRODUCTION & CONTEXT
Design sketching within product design (PD) and industrial design (ID) education at HE level is a core subject. It is noted by several academics including Aldoy and Evans [1], that there are opportunities for development of learning and teaching in this area of the ID/PD curriculum. Fava [2] also identifies that drawing as process is emphasized in HE, however, lecturers are often concerned about an over-emphasis on outcomes rather than process. In recent years the use of digital tools/platforms within design sketching has dramatically increased and there is evidence that shows that digital sketching and haptic sketch modeling can be very beneficial [3]. Although digital tools have many benefits, they have also had an impact on traditional skills, leading to a perceived decrease in drawing abilities. This will only be further impacted with the expected rapid rise in AI sketch to image generators/tools such as NewArc.Ai, Vizxom etc. With the general population shifting towards a more technology driven society, this is also starting to impact design education at primary and secondary level with growing enthusiasm shown for technology focused approaches rather than being considerate of traditional skills.
Secondary school design courses often focus on the basics, leaving students with limited exposure to more advanced sketching techniques and tools commonly used in HE and the industry. Ensuring that students gain this new knowledge gradually is an important factor to consider when preparing a design

sketching syllabus. The teaching of core design sketching skills within the HE environment coupled with the greater expectation for ideation/iteration in a design studio context is a hurdle most students face and subsequently, this has an impact on the quality and quantity of work produced. Many students often favour computer aided design approaches to visualise their ideas, however Hilton et al identified that it is often necessary to go back to basics and encourage sketching over CAD skills, with this being deemed critical to improving essential engineering design skills [4]. The shift in expectations from secondary education to HE can be overwhelming for students who are not adequately prepared and as such it is important to understand this transition and educational pathway to suitably prepare taught design sketching content. Challenges arise as students increasingly favour digital design, neglecting traditional approaches. Students fail to recognize the importance of practicing/mastering fundamental design sketching skills before moving to digital alternatives. Consequently, they often design within the limitations of digital tools, neglecting essential steps in the design process.

This paper discusses the design sketching background of students entering UK HE in the PD sector. We seek to examine the PD student design sketching pathway by exploring the education background prior to joining NTU, the design sketching education conducted at NTU within the first-year studies, and the aspirations of students moving forward with regards to preferred future education syllabi and their thoughts on design sketching in the industry context. We also seek to understand the hurdles faced when trying to implement a seamless transition from secondary education to HE whilst attempting to further understand the needs/wants of PD students. To conclude we will present recommendations with regards to traditional/digital design sketching for higher education syllabus development and implementation.

2   POINTS OF ENTRY

Within the PD/ID sector, the transition from secondary education to HE in the UK used to be aided by enrolling in a preparatory year at a foundation education institution such as an art college. This period played a vital role enabling individuals with a passion for the creative fields to delve into various specialties. However, in the modern era of UK HE it is reported by the Higher Education Statistics Agency (HESA) that the trend of students enrolling directly in degree-level courses is increasing, with a decrease in students pursuing foundation degree level qualifications [5]. As such, the design sketching skills presented by incoming first year students often demonstrate a lack of understanding of perspective and proportion. When exploring the factors that have affected the decline in core/fundamental skills in recent years, this can be attributed to the COVID-19 pandemic and absence of face to face/practical teaching. However, many of these issues can be attributed to the decline in design and technology teaching in schools. The Education Policy Institute identified that the number of students entering D&T qualifications has declined considerably with just 22% of GCSE students having at least one D&T qualification in 2020, compared to 44% in 2009; this represents a decline of 280,000 to 136,000 students studying D&T [6]. This has also impacted D&T teacher numbers and the skill set attributed to them.

To better understand the factors contributing to the competency of students when entering HE, the syllabuses and assessment guidance provided by examination boards to secondary schools was consulted. One examination board highlights several key positive points such as, encouraging students to build confidence by developing communication and drawing skills as designers rather than artists, in addition to encouraging quick sketching skills for communicating initial design ideas. However, the documentation also states that it is important for learners to understand that they are not assessed on how well they can sketch, which is somewhat surprising, potentially lessening the perceived importance of sketching by students [7]. Further to this, another exam board sets maximum (NEA project) page parameters [8] meaning that with such a tightly controlled portfolio the time and space available to develop design sketching/communication skills is difficult, which means from a teaching perspective the amount of time dedicated to this skill is diminishing. As a result of the falling number of students studying D&T, the limitations placed on creativity and exploration by exam boards and the contradictory guidance provided has inevitably resulted in a significant and clearly discernible disparity in student skill sets entering PD at HE, hence the need for subject specific syllabuses such as design sketching.

3   DESIGN SKETCHING 1ST YEAR SYLLABUS OVERVIEW

Upon joining NTU students undertake a 24-week design sketching syllabus within their first year of studies prior to undertaking a 15-week design sketching syllabus in their second year. To transition the varying skill levels of students, the initial 24-week syllabus focusses on traditional design sketching skills with weekly one hour thirty-minute classes. Weeks 1-3 focus on exploring basic form, perspective,

and proportions of sketching to provide a foundation of basic skills to develop upon. Next, weeks 4-7 build upon this exploring the general methodologies and approaches of basic elliptical and circular forms alongside methodologies for construction of forms using contoured lines and sectional shapes. Weeks 8-10 focuses both on refining detail, through transitional forms such as fillets and blends, alongside developing methodologies to further increase spatial cognition, and frameworks for implementation. Alongside this, learning is completed on the application of colour/shading in relation to–perspective forms. Weeks 11-12 continues exploring the use of colour in relation to form, through shading and texture using markers, chalk pastels and colouring pencils. Weeks 13-16 focuses on exploring products, form and proportion, sketch work narrative, product detailing, design narrative and dynamic expression of views. Weeks 17-20 focus is on utilising mini design briefs to develop independence and sketch competency through product interrogation, product sketches, interfaces, detailed forms, and human interaction. The final four weeks focus on an exploded sketch assignment where the students learning is evaluated through the production of individual component drawings and the final exploded sketch.

4 METHODS

Sixty BA Product Design Students second years and fifty-five BSc Product Design second years who had successfully completed their first-year studies at NTU were given the opportunity to complete the PD year one design sketching review survey. Sixty-seven students responded to the survey, thirty BA PD students and thirty-seven BSc PD students, representing a response rate of 58.2%. Distribution of the survey was conducted via in person briefings and several e-mail circulations. The thirty-one-question survey was reviewed and approved by the AADH Research Ethic Committee at Nottingham Trent University. The survey was curated on Microsoft Forms and was made available for a two-week period. The survey consisted of open ended and close ended questions which were utilised to gain a variety of insights regarding the PD year one design sketching syllabus and teaching approaches. The type of data collected varied from student testimonials, Likert scale question data, rating scale data and open text box question responses. Quantitative data was extracted and refined within a Microsoft Excel spreadsheet with a comparative analysis approach undertaken. Student demographic data, course data and prior education data collected enabled us to assess whether any trends can be established. Students aged 18 – 24 completed the survey highlighting varying education backgrounds ranging from GCSE's, A-Levels, BTEC's, International Baccalaureates, Art Foundation courses, amongst others. Student prior education backgrounds varied from no prior experience with creative subjects to three/four relevant qualifications. A summary of the key results and findings is presented in section five.

5 RESULTS

Upon reviewing the general perception of the students perceived sketching ability prior to joining NTU, students rated their design sketching skills as, very poor 4.5%, poor 22.5%, satisfactory 38.8%, good 20.9%, very good 9% and excellent 4.5%. However, after completing the design sketching syllabus, students rated their perceived design sketching skills as satisfactory 26.9%, good 50.7%, very good 19.4% and excellent 3%; no student rated their perceived skill level as poor or very poor. The percentage of students rating their skill level as excellent decreased, this could be due to an inflated perceived skill level prior to gaining a full understanding of perspective/proportion and the expectations from HE and industry. The overall experience with design sketching classes was rated at an average of 3.96/5.0, with BA PD averaging at 4.1/5.0 and BSc PD at 3.9/5.0. The main differences between the two student groups are small subject specific differences in the syllabus and the tutor team that delivers the content.

Students were also asked to identify how important they thought design sketching classes were for their development as a product designer of which 1.5% of students respectively said it was "not important at all" or "somewhat not important", whereas 7.5% of students provided a neutral opinion with 34.3% of students stating is "somewhat important" and 55.2% stating it is "extremely important". However, when asked how important they thought design sketching skills are for their future professional practice in industry, 1.5% of students respectively said it was "not important at all", 4.5% students state it is "somewhat not important", whereas 14.9% of students provided a neutral opinion with 26.9% of students stating is "somewhat important" and 52.2% stating it is "extremely important". The slight drop in perceived importance may be attributed to the desirable industries that the students may seek to work in, with many of the BSc PD students seeking more technical or CAD focussed roles. For many students, engaging with design sketching can be quite a frustrating activity, especially for the BSc PD students who often struggle more with design sketching as a subject. When asking students about their level of

frustration when engaging with design sketching as an activity, 6% of students find it very frustrating, with 26.9% of students finding it frustrating. Conversely, 32.8% of students find design sketching "neither frustrating nor satisfying" but 28.4% of students find design sketching activities "satisfying" with 6% of students finding it "very satisfying". As demonstrated in Figure 1 the student perceived design sketching skill level/confidence level prior to studying 1st year PD and after completion of the 24-week syllabus dramatically increases. Most importantly all the core design sketching skills such as sketching with pens, pencils, use of fine tip pens/fine liners to communicate have moved to an acceptable or a greater outcome. With more complex skills/tools to master such as using rendering makers, sharpie's, coloured pencils for sketching and rendering, all these areas drastically improved, and of note only a few students still had negative responses.
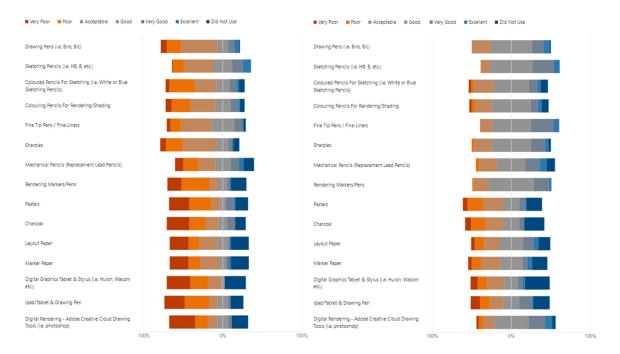

Figure 1. Student perceived skill level/confidence level prior to studying 1st year product design (Left); Student perceived skill level/confidence level after studying 1st year product design (Right)

An interesting outcome from the survey was the student perception on how important they think practicing design sketching is in relation to their ability to complete project work and design sketching assignments. Only 1.5% of students and 4.5% of students think that practicing design sketching is either "very unimportant" or "unimportant", whereas 11.9% of students take a neutral view, with 55.2% of students rating this as "important" and 26.9% of students rating this "extremely important". Contradictory to this, when the students were asked how many hours per week, they practiced their design sketching outside of classes (i.e. sketch work not related to project or a class), 32.8% of students do not do any practice outside of sketching classes with 29.9% of students only completing 1-2 hours of practice. 23.9% of students practice 3-4 hours per week with 9% of students practicing 5-6 hours per week and 4.5% of student practicing 7-8 hours per week. Interestingly the number of students who fail to practice any sketching per week is equal for both the BSc PD and BA PD courses. Student feedback identified several areas where improvements could be made to the syllabus design. Suggestions included, assigning sketch activities/tasks between design sketching classes, weekly one-page assignments to force students to practice, providing guidance on transitioning from traditional to digital outputs, sessions on sketch work editing in 2D/3D CAD platforms, providing support on page composition, and providing opportunities for exploration with a wider variety of mediums.

Assign more tasks for students to hand in every sketch session, for example, when doing exploded views during the session, set an exploded view drawing of an object of the student's choice, due for the next session (P12).

Apart from helping us more with the transition from physical to digital i.e., moving designs on paper to photoshop and making sure they're presentable (P19).

We could do traditional to digital sketching tools studies. Could do with learning all the features on a digital sketching platform for introduction to it. (P27).

More space to choose what medium is used to a point i.e. range of pencils and pens but not too technical too quickly such as charcoals and pastels (P52).

Having a hand in every week of a single page of non-project sketching as a way to ensure student's practice (P59).

Although a number of these recommendations are valid, some of the recommendations do need to be carefully reflected upon to consider the full spectrum of abilities of the student cohort. Providing weekly deliverables for sketching classes although a great idea in practice, could result in loss of student engagement with classes or result in students having a sense of perfectionism due to trying to polish every page. Conversely this could create issues with imposter syndrome whereby students compare themselves to one another and the lower achievers stop engaging with classes due to comparing themselves to a peer whose skills may be significantly better. Another factor to consider with sketching assignments is that the current student mindset is to work deadline to deadline, as they struggle to manage multiple project/submissions. Contributing to this further could negatively impact project work deadlines. Providing opportunities to explore with a greater variety of mediums again could be integrated, but this must be done strategically so not to overwhelm students, yet at the same time we should not deviate from teaching the core principles. Additionally, it is imperative to consider the class as a whole and the varying student skill set which may differ class to class on a yearly basis. Within the PD subject, students come from varying backgrounds ranging from design technology, art, engineering, sciences, business, amongst others, and as such some students have no background in design sketching. Flexibility in the syllabus and the variety of activities and demonstrations available would provide students with the opportunity to not only improve their core skills but also give students who are more proficient the opportunity to expand their skill set further.

Based on the collected feedback it is clear that key areas demanding attention for improvement include elevating levels of 3D spatial awareness and cognition, instilling confidence, exploring problem-solving through construction methodologies, engaging through illustration, recognizing the importance of detail, effectively communicating technical narratives and annotations, creating a sense of accomplishment in one's work, and ultimately cultivating a practice that actively encourages engagement/attendance.

6   DISCUSSION, CONCLUSIONS & RECOMMENDATIONS

This paper has identified the substantial differences in the entry points and early education experiences of design students entering HE who are studying at secondary and foundation education level. It is evident that recent alterations in the pathways to higher education have had an impact and negatively influenced the fundamental skill levels of students, particularly in design sketching. As such a key recommendation for all PD courses in HE is that a well-structured/detailed design sketching syllabus is required within the first year of studies covering the core principles resisting the urge to delve into digital and AI activities before the core principles have been taught and evidenced.

The foundation of the design sketching syllabus described in section 3 is formulated on the principles of upskilling all first year PD students to a similar level in terms of the skills and competencies required to succeed in HE. As such core values such as instilling confidence, practicing skills through repetition, reinforcing reflection and critique, applying sketch development techniques, and incorporating diverse activities help reinforce continuous improvement. Additionally, course identity and alignment with industrial perspectives play crucial roles in ensuring students comprehend the significance and motivations underlying their education. As identified in the results section, a worrying trend identified is that most students either do no practice their designs sketching skills or practice these for a small period of time, regardless of the consistent reminder by staff/tutors to do so. Conversely, 74.6% of students identified that they would be prepared to undertake more sketching assignments based on their design sketching classes if they were to receive a graded outcome or written/verbal feedback. As such it is clear that students place more value in completing project work/assignments where assessments are involved rather than self-directed skills development. Encouraging autonomy is a core value at higher

education level and as such finding methods to engage students with passion projects or design sketching activities that encourage students to practice the fundamental skills is important.

An interesting finding from the survey identified that students would be willing to learn more about artificial intelligence text to image idea/concept generation (Y:70.1% N:18% M:11.9%). Also, many students want to learn more about digital sketching using drawing tablets, graphic tablets (Y:88% N:12% M:0%) and also want to learn more about virtual reality design sketching i.e. idea/concept generation in a 3D space using VR headsets (Y:70.1% N:29.9% M:0%). Conversely, 73.1% of students stated that their preferred method of design sketching would still be via traditional methods (i.e. pen/pencil). When this survey was conducted all students had been exposed to digital sketching, text to image AI and VR sketching and as such this highlights the importance of teaching the fundamentals of design sketching as a core aspect of a PD courses syllabus. Critically, although there is rapid growth in digital, immersive, and AI technologies which is providing expanded opportunities within design sketching, ideation, development, and concept visualization, based on the point of entry information and the survey data collected and through holistic observations, it is imperative that students master the fundamentals before embracing the complexity of digital tools. Another important factor to consider is that when setting tasks within design sketching sessions, students prefer a mixture of tasks that are not directly related to their studio project work, but also want occasional tasks/project focussed sketching classes that help them improve their project work or provide the initial upskilling required.

Key recommendations for design educators when developing design sketching syllabuses include gaining a full understanding of the student cohorts' previous education at point of entry, whilst also getting comprehensive data via a skills audit. This would allow the syllabus content to be tailored to the correct level. Regular design sketching classes on a weekly basis for a minimum of the first two years of study is crucial for imparting the fundamental skills. While the rapid advancements in digital, immersive, and artificial intelligence (AI) technologies for design sketching provide many opportunities/advantages, strategic implementation is required. Design sketching syllabuses should be taught methodically and systematically by gradually introducing skills steadily over a sustained period of time so not to overwhelm students. Finally, syllabuses implemented should be tailored to the courses specialism to ensure students see the value/relevance to the course assignments as well as a clear connection to industrial employability. In conclusion, it is critical that students develop design sketching throughout their time in HE, by gaining confidence in this core skillset, this will not only improve their proficiency in this specific skillset, but it will also translate to their overall communication as a designer, both with in design projects and within their professional practice in industry.

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