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The Power Of The Pen/Pencil: Developing A Design Sketching Syllabus To Help 1st Year Product Design Students Communicate Effectively

Paul Kennea
Product Design Department, School of Architecture Design & The Built Environment, Nottingham Trent University, Nottingham, United Kingdom

Richard Malcolm
Product Design Department, School of Architecture Design & The Built Environment, Nottingham Trent University, Nottingham, United Kingdom

Francesco Luke Siena
Product Design Department, School of Architecture Design & The Built Environment, Nottingham Trent University, Nottingham, United Kingdom

Joseph Stewart
Product Design Department, School of Architecture Design & The Built Environment, Nottingham Trent University, Nottingham, United Kingdom

Allan Cutts
Product Design Department, School of Architecture Design & The Built Environment, Nottingham Trent University, Nottingham, United Kingdom

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Paul Kennea[a], Richard Malcolm[a], Francesco Luke Siena[a*], Joseph Stewart[a], Allan Cutts[a]

[a] Product Design Department, School of Architecture Design & The Built Environment, Nottingham Trent University, Nottingham, United Kingdom.

*Corresponding author e-mail: luke.siena@ntu.ac.uk

Abstract: Digital, immersive, and artificial intelligence (AI) technologies have propelled technology-focused design to the fore. Due to our technology-driven society and growing demand for technology literacy, the perceived need for traditional/analogue skills is being overlooked/underappreciated. Within product design (PD) education, students are increasingly embracing digital design tools to communicate, overlooking traditional/analogue tools. Subsequently, students are increasingly designing within the remits/restrictions of digital tools. This presents numerous challenges, including overreliance on computer aided design tools, perfectionism through corrective tools available with digital sketching platforms, and the complete disregard of quick concept generation in favor of AI. The power of the pen/pencil is being lost affecting the learning/appreciation of fundamental principles of design sketching/communication, a core skill required of every product designer. This paper presents our philosophical standpoint on design sketching and the development of a 24-week design sketching syllabus for product design 1st-year students focused on fundamental/traditional skills.

Keywords: Design Sketching; Sketching; Product Design Education; Product Design Curriculum.

1. Introduction

In recent years, there has been a significant increase in the use of digital, immersive, and artificial intelligence (AI) technologies in product design (PD) education. Educators have explored the potential of these technologies for the design process, including digital design sketching on tablets/PCs (Evans & Aldoy, 2016), virtual reality sketching for ideation and prototyping (Joundi et al., 2020), digital sketching and haptic sketch modeling (Evans et al., 2015), and AI-based inspiration for ideation (Kim et al., 2021). While these digital tools have

greatly benefited product designers and design engineers, they have had an impact on traditional skills such as design sketching, leading to a decline in drawing abilities in recent years. Research by Fava (2019) acknowledges that in some industries, drawing is no longer deemed essential due to the prevalence of digital, immersive, and AI technologies, although the skill set remains desirable.

Design sketching, however, at higher education level is essential and Fava (2019) identifies that 'drawing as process is emphasized in higher education' with lecturer's concerned about an over-emphasis on outcomes rather than process. Hilton et al., (2018) argues that it is necessary to go back to basics and encourage sketching over CAD skills as this was deemed key to improving essential engineering design skills.

Sketching and drawing skills are fundamental in a designer's toolkit and this is acknowledged by secondary education examination boards and higher education design courses. However, the time dedicated to this skill varies between institutions due to pressure from examination boards, course accreditors, and the educator's skill set. In recent years, industry has noted a gap in design sketching education, with influencers like Marius Kindler (Kindler, 2023) and Spencer Nugent (Nugent, n.d.) subsequently launching sketching courses.

This paper argues that 'The Power of The Pen/Pencil' remains significant. It presents the context/need for a development of a design sketching syllabus for first-year PD students, focusing on traditional design sketching skills. A point of entry understanding is necessary to fully understand the contextual need for a robust sketching syllabus. Only after undertaking our 1st year syllabus are students encouraged to explore digital, immersive, and artificial intelligence (AI) technologies. This paper also contextualizes the need for a structured design sketching syllabus, offering insights based on the UK education system, especially in relation to the barriers inadvertently set by secondary education providers.

2. Context

Design sketching as a taught subject is extremely important. Industry employers often look for a balanced skill set when recruiting new graduate designers with sketching, CAD, visual presentation, creative and design literacy deemed essential. Often the deficiency seen in design graduates is a lack of confidence and ability in design sketching. When teaching design sketching it is important to consider a wide range of factors including sketch quality, creativity, confidence, sketch page composition, amongst others. Kudrowitz et al., (2012) identified that the influence of sketch quality on the perception of product-idea creativity is essential, thus supporting the need for sketching tuition.

Frequency in design sketching tuition is another key factor observed in relation to the development and perceived success of a sketch by students. Research conducted by Yang and Cham (2006) analyzing sketching skills and its role in early-stage engineering design suggests that designers who are given sketching instructions often draw more overall. Cham & Yang (2005) also found a positive correlation between the quantity of sketches produced and

sketch skills, suggesting that students provided with explicit instructions in sketching produce more drawings.

Waanders et al., (2011) emphasized that design sketching goes beyond mere accurate drawings. When students receive lessons focusing on sketching techniques and processes, they become not only better sketchers but also better designers. Building confidence is crucial in developing design sketching skills, as van Passel and Eggink (2013) discussed. Teaching sketching skills positively influences self-esteem, accelerates skill development, and elevates skills to a higher level. Dong et al., (2013) also suggests that setting structured, timed tasks for daily practice, creating a relaxing peer-learning environment, and organizing intensive drawing workshops will help enhance design sketching learning.

Teaching design sketching in the age of digital, immersive, and AI technologies poses challenges, particularly the tendency towards perfectionism facilitated by the ability to endlessly edit sketches in digital platforms. Das et al. (2022) found that sketch quality is highest for pencil drawings but lower for tablet and pen drawings, as students miss the tactile feedback and can be distracted by excessive tool features. On the other hand, Bernardo & Duarte (2022) observed that students view the use of VR tools like Gravity Sketch positively, but teaching this approach is challenging due to the increased information required for effective communication. Therefore, traditional design sketching instruction continues to be well-received and relevant in the current curriculum.

3. Point of Entry

A key point to consider upon point of entry into higher education is a student's sketching ability. In recent years it has been noted that the general entry standard of sketching and sketch-based communication has fallen considerably across the first-year product design courses at NTU. Before discussing reasons for this, a snapshot of the route applicants take before joining a NTU product design course needs to be considered.

At Nottingham Trent University (NTU) our BA PD courses, prospective students need to achieve a UCAS points tariff of 112pts (Grades: B, B, C). While neither design and technology (D&T) or art are not explicitly required, all applicants must prepare a portfolio and attend an interview in person or online. During interviews, sketching ability is evaluated. Students from a D&T or similar background often struggle with communication, producing limited sketching content in a cluttered, text-heavy presentation format. Those from an art background show more creative freedom and extensive sketch work but sometimes lack clarity in communication. For our BSc PD course, the tariff point requirements remain the same, but there's no interview. As a result, sketching ability becomes an unknown factor and is only assessed upon arrival.

Regardless of the route taken before joining higher education, recent observations have demonstrated that the majority of first year product design students, at the very least, lack an understanding of perspective and proportion. Furthermore, there was a definite need for

students to adopt and develop a sketching style that allows for design communication with a greater level of clarity.

To understand the reasons for this situation in more detail, a closer look at the school system was required. Initial research with secondary schools has had a particular focus on sketching, and communication. Research carried out with D&T teachers at this juncture highlighted potential factors contributing to the issues observed.

It became quickly apparent that a more holistic view of D&T in schools was needed and therefore both GCSE and A-level syllabi were consulted. From the exam/course specifications and guidelines available online, it was discovered that the syllabus and associated non-examined assessment (NEA) coursework/exam requirements for D&T (Product Design) differed slightly according to the exam board the school aligned with, with the importance and prominence of sketching promoted to varying degrees. The GCSE guidance included points that were agreed with, with students encouraged to, build confidence through developing skills in communication and drawing as a designer rather than as artist, and develop quick sketching skills to communicate initial design ideas (OCR, 2016a).

However, this documentation also stated that it was important for learners to understand that they are not assessed on how well they can sketch (OCR, 2016a) which seemed at odds with the stated aims regarding sketching. A target would surely be beneficial in incentivizing students to concentrate more on sketching and developing greater skills. Taking this into account, the step to A-level guidance appeared significant and according to the following, poor quality sketching meaning learners struggle to convey simple concepts or have difficulty realizing them in the first place (OCR, 2016b).

An area of difference in the guidance was in relation to project portfolio length, with one exam board setting no limit but another limiting the page count to not exceed 45 (AQA, 2016). In such a tightly controlled portfolio the time and space need to develop and demonstrate design sketching/communication skills would be difficult. This did raise a question as to how teachers were advised to teach sketching. There was some guidance on this including a suggested session plan, but the question remained as to how this was being delivered in classrooms. From discussions in schools, design sketching was highlighted as a challenging area with D&T teachers looking for support.

It was important to consider how this translated to the first-year cohort, with several issues coming to the fore during the year 1 sketching course. A major stumbling block for some was simply the belief that they could not sketch, thus demonstrating a lack of confidence. Another challenge was a 'fear of failure' if they could not complete a sketching exercise attempted in a session. Others started to get disheartened at times if they strived for a perfect sketch but did not achieve their desired outcome. Ultimately this led to some students displaying a lack of willingness to try during sessions or trying once then giving up. On a practical level, many students were reluctant to abandon sketching using supportive tools such as a ruler to draw straight lines, which impacted the flow, speed, and dynamism/energy of their work. It was also observed that students followed on screen demonstrations well, however, when tasks

were set that did not involve a demonstration and asked students to apply taught skills, a number struggled.

The result of this is that a small but growing number of students turn to digital sketching from the outset of their university course. It is perhaps understandable that some would choose to do this, allowing straightening of lines and smoothing ellipses, however, it is too easy to press delete and return to a blank page. Furthermore, digital sketching reduces the opportunity to learn from mistakes and the chance of serendipity if incorrect lines are simply deleted immediately, with students perhaps overlooking exploration of more interesting design iterations. What has become abundantly clear is that students, whether sketching on paper or digitally, need a solid foundational understanding of perspective and proportion to produce convincing sketch communication.

It has also been noted that a growing number of students are keen to jump to 3D CAD from the minute they join the course. Encouraging students to design and push the limits of their creativity rather than relying on the limitations of CAD software was seen as key. Following consideration of the GCSE and A-level syllabi and the stated aims, some of the issues/challenges presented by first-year cohorts at the point of entry were surprising, however, further, more in-depth, research would be required to understand this more fully.

4. Design Sketching Challenges & Philosophical Viewpoint

The transition from secondary education to higher education in the UK was once eased by undertaking a foundation year at institutions like art colleges. This year served as a crucial bridge, allowing those passionate about the creative sectors to explore different specialisms. Pre-university students interested in creative industries could develop their creative skills while gaining insights into the sector, honing their abilities, and defining their individual identities. In the modern era of UK higher education, the Higher Education Statistics Agency (HESA) reports a growing trend of students enrolling directly in degree-level courses, with a decrease in students pursuing foundation degree level qualifications (HESA, 2023). This shift can be attributed to the "Creativity Crisis" prevalent in schools due to significant cuts in art funding across the UK (Weale, 2021).

Notably, the number of students entering design and technology (D&T) qualifications has declined considerably in recent years. In 2020, just 22% of GCSE students had at least one D&T entry, compared to 44% in 2009. In 2009, there were 280,000 total GCSE D&T subject entries, but by 2020, this had fallen to 136,000 (Tuckett, 2022). Significant funding cuts in 2021 (Harris, 2021) have led to a decrease in the number of students enrolled in creative courses, affecting the quality of resources and teaching. This has impacted the teaching of traditional skills like design sketching, pushing aspiring designers towards digital tools and resources. Furthermore, the demand for STEM subjects, driven by UK government policy and the rise of digital technologies and artificial intelligence, has led students to explore other educational options. This reduces the likelihood of engaging with arts or design-based subjects, despite calls from educators to incorporate art within a STEAM reform.

It used to be expected that students starting a creative course at diploma or degree level had fundamental skills like drawing, sketching, modeling, and applying methodologies. Within the field of industrial design/product design, the method in which students could be iterative by approach and ideate initial ideas through to finished concepts through sketching was taken for granted. However, in the current education paradigm it is now necessary to determine by what level a student can fundamentally carry out the tasks of sketching shapes and forms, to realize their ideas, which is a significant step backwards in the tuition of creatives at higher education level. A key driver for this was universities in the UK starting to take students directly from schools and colleges in the early 2000's, and the reduction of the interview to determine skill levels due to the drive to increase student numbers within higher education establishments. As such we began to see the stark difference between those that had, and those that hadn't had this bridging year, and the fundamental tuition on key skills such as design sketching.

In the current education climate, the norm is to recruit students now directly from secondary school. The creative talent within these students still exists, but what is missing is any consistency in approach, and crucially any coherent vocational skill set. This challenge is compounded by the increasing number of international students with varying cultural and vocational backgrounds whereby these skills are undervalued by their relative education systems. Consequently, some students fail to reach their full potential due to educational gaps and disparities in standards both across different regions of the UK and internationally. Fundamentally, it comes down to either level of exposure, or worst-case scenario, whether the students have had any exposure at all.

Additionally domestic differences could come down to regional interpretations, local education authority mandates, a school's approach, an educator's background, or the fundamental interpretation of the 'one size fits all' national curriculum. Public and private schooling also began to take a role in opportunities afforded to students. As such the exposure to the variety of basic skills required for creative courses, most notably within design sketching has meant that the skills divide between individual students and different cohorts is significant and varies annually.

Unfortunately, differences in exposure are often self-misdiagnosed as a lack of ability, leading some students to become despondent and seek shortcuts to visualize their designs. They turn to various methods, such as digital sketching programs with corrective tools, artificial intelligence ideation, and direct use of engineering CAD (Computer Aided Design). The use, quality, and diversity of design sketching has become noticeable. While digital approaches are important and growing in demand, it's crucial to ensure that all methods are taught to students, rather than drifting to digital skills and replacing traditional sketching methods.

At NTU, we recognize the vital importance of the 1st year. It serves not only to transition students from school but also to jumpstart their design education. The first year is a crucial formative period, tailored to meet the varying needs of our students to align with industry demands. Through triaging, we identified that 'Design Sketching' needed to be addressed. This was the principal facilitator that would drive all vocational directions. Design Sketching

needed to be seen as a skill fundamentally different from drawing and art, with demonstrable and measurable parallels to the manufacturing and design world.

What is important, is to instill a skill set and a mindset, ensuring students undertake this within 'foundation principles' set within the framework of the 1st year experience. We needed through running sketching classes, to instill approaches of form creation, and through this allow students to see this as a 'toolkit' to drive creativity, innovation, and original thought. Design sketching once again needed to become the medium through which students can creatively articulate their design process. To achieve this, we developed and implemented an updated 24-week design sketching syllabus that not only covered essential skills but also established connections between project work and industry needs. This curriculum was informed by both external and internal feedback and drivers.

Key areas requiring consideration for development included increasing levels of 3D spatial awareness and cognition, confidence of application, approaches to form creation, problem solving through construction methodologies, engaging through illustration, importance of detail, communication of technical narratives and annotations, creating a sense of accomplishment and pride in one's work and ultimately developing a practice that actively encourages engagement and attendance.

5. Design Sketching Syllabus Development

In 2010, the need for structured design sketching classes was identified, primarily to assist BSc PD students. These students lacked design sketching skills due to their backgrounds in the technical realms of design and technology, engineering, sciences, and information technology, as opposed to the art and humanities background of BA PD students. Initially, holistic observations made appeared to identify that BSc PD students were falling behind their BA counterparts due to design sketching deficiencies. Later, this structured training was extended to BA students as entry requirements changed. Effective tuition needed to align with students' evolving needs and abilities, which vary annually. Therefore, the early years of syllabus development involved studying different approaches/delivery methods to determine the most effective approach.

Initial observations revealed the benefits of teaching construction methodologies akin to traditional draughting practices. However, students lacked structure and framework in their sketching. Academics teaching within a designed system would serve two purposes, firstly, to be diagnostic to how students coped with sessions, and second, to give students a structure and framework to work within, which would instill a lifelong approach, opposed to a transitory one.

To develop a design sketching syllabus suitable for both BA and BSc PD students, this was divided into three parts. First, a core set of ten sessions explored key design sketching principles. Second, both courses were provided with specialized design sketching sessions for ten weeks. Finally, both courses concluded the syllabus with a core four-week exploded sketch assignment/assessment.

## 5.1 Core Design Sketching Syllabus – 10 Weeks

To begin, the initial core ten-week design sketching syllabus key focus/driver was to concentrate on 'perspective' drawing and construction methodologies with all the implications this entails. To do so, the initial ten weeks is divided into three sections:

- **Weeks 1 – 3:** Exploring basic form, perspective, and proportions of sketching to provide a foundation of basic skills to develop upon (Table 1).

- **Weeks 4 – 7:** Exploring general methodologies and approaches of basic elliptical and circular forms alongside methodologies for construction of forms using contoured lines and sectional shapes (Table 2).

- **Weeks 8 – 10:** Developing on refining detail through transitional forms such as fillets and blends, alongside developing methodologies to further increase spatial cognition, and frameworks for implementation. Also learning the application of color and shading in relation to perspective forms (Table 3).

To supplement the weekly 1.5 hour taught sessions, each teaching block is accompanied by pre-recordings of sessions with sketch demonstrations of the activities and a detailed breakdown of the techniques taught.

Table 1   Initial three weeks of design sketching classes exploring basic form, perspective, and proportions of sketching.

Session No.	Sketch Class Description	Exercises
1	Assessing incoming student ability and knowledge.	• Understanding the underpinnings, but restrictions of traditional 2-point perspective creation, through constructed vanishing points. • Explore methods of creating/controlling perspective sketching, by understanding the body as a mechanism, and the workspace as a dynamic environment. • Creating perspective cubes without the need for perspective grids. Exploring line creation, and line weights.
2	Learning to read a series of increasingly complex orthographic elevations, to create perspective forms.	• Breakdown of approaches of construction to allow for the creation of forms that will be faceted but have complex geometry. • Explore/understand the reason for perspective orientation and create four geometric 1st and 3rd angle elevation views of structurally complex forms (Figure 1).
3	Keeping consistency within perspective orientation through looking at the linear projection of nested exploded forms.	• Exploring construction methodologies to help solve complex problems. • Create an exploded 'Rubik's' cube, and 3-part puzzle. Use strategic rules that challenge spatial cognition.
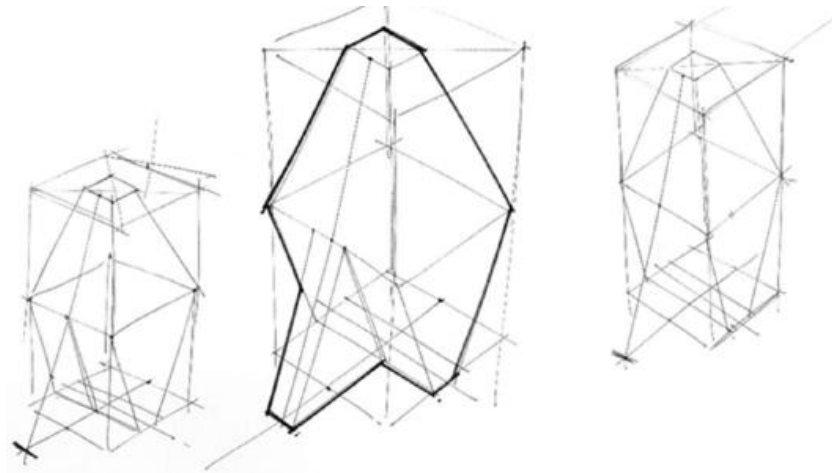
Figure 1 Sketching process of geometric 1st and 3rd angle elevation views of structurally complex forms using geometric construction lines. (Credit: Paul Kennea)

Table 2 Weeks 4-7 exploring general methodologies of basic elliptical and circular forms and contoured objects using construction approaches.

| Session No.	Sketch Class Description	Exercises
4	Construction of ellipses and circular objects utilizing boxes and plane construction approaches.	• Understanding the sketching of cones/cylinders exploring general methodologies/approaches of basic elliptical and circular forms within perspective orientations. • Interrogation of elevation drawings depicting forms with linear and radial features. Complete a series of 3D studies, requiring construction approaches for both linear and circular integrated forms (Figure 2).
5	Continuing the theme of cylinders, and elliptical forms.	• Apply orthographic drawing approaches to construct a perspective drawing of an SLR camera (Figure 3). • Demonstrate the application of construction, proportion, and detail to SLR camera features.
6	Approaching rounded corners on perspective forms, from method to implementation.	• Examination of differing radii, and types of radii blends. • Explore illustrative approaches using line weights. • Demonstrate rounding corners of a cuboid before developing a cruciform form, with rounded corners.
7	Methodologies for construction of forms using contoured lines, and sectional shapes through vector lines.	• Explore other approaches to perspective creation. • Complete a series of sketches of water bottles, vases and sculptural forms leading to the 'my contour family' activity. • Application of line weights to elevate objects in front of others through shading and hatching.
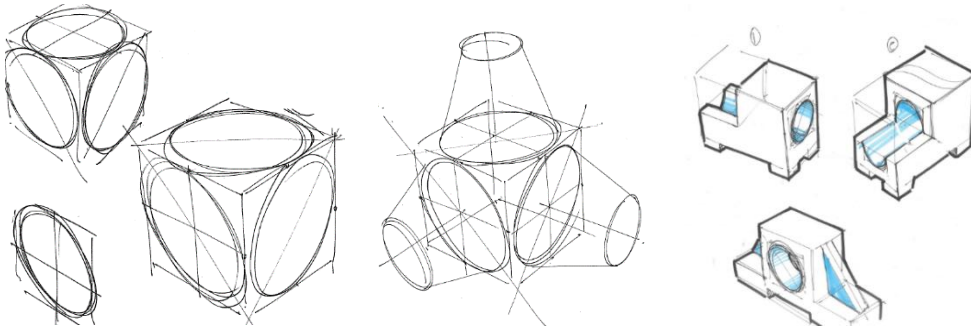
Figure 2   Construction of ellipses utilizing box and plane construction methods before developing cones and cylindrical forms and circular integrated forms. (Credit: Paul Kennea)
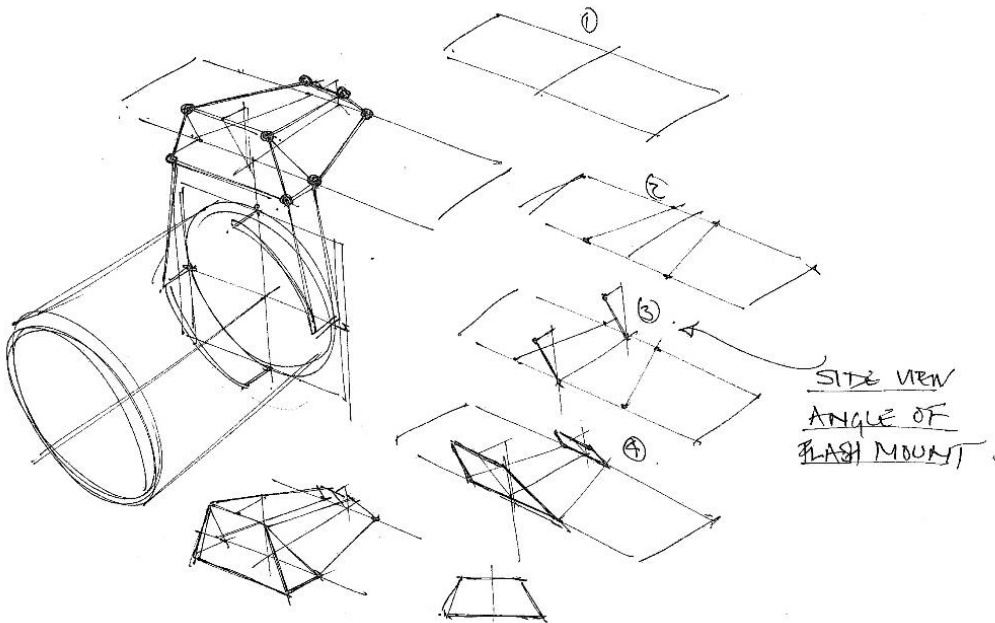

Figure 3   Applying orthographic drawing approaches to construct a perspective drawing of an SLR camera. (Credit: Paul Kennea)

Table 3   Initial three weeks of design sketching classes exploring basic form, perspective, and proportions of sketching.

Session No.	Sketch Class Description	Exercises
8	Cognitive mapping within design sketching.	• Cognitive mapping exercise through the cubic challenge (Figure 4) to challenge students' spatial cognition exploring narrative through visual annotation and hinged forms.
9	Sketching methodologies for creating a designed artefact.	• To design and sketch a series of Coffee/Espresso makers. • Explore detail, scale, proportion, and user narratives. • Create forms that are robust with definition using line weights, a range of construction approaches and technical annotation.
10	The process of color and sharing in relation to linear forms.	• Demonstrating an understanding of light and direction, pattern, and texture. • Sketch architectural perspective forms with the application of light and shaded tones. • Sketch and render a 4-block installation which embodies balancing forms, of differing material finishes.
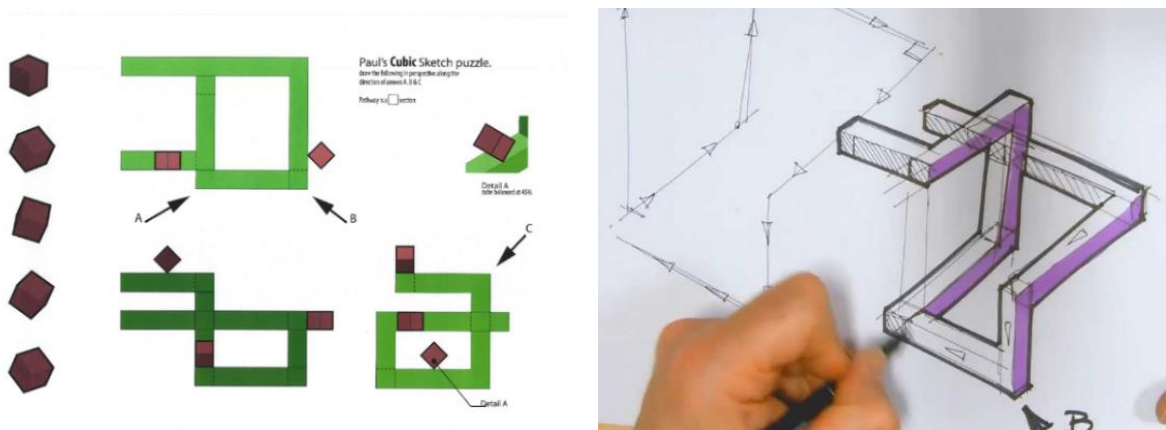
Figure 4   Cubic challenge cube – creating narrative through hinging detail and annotation with 2D/3D view observation. (Credit: Paul Kennea)

5.2 BA Product Design Course Specific Sketching Syllabus – 10 Weeks

The development of the next ten weeks of the design sketching syllabus for the BA PD students is derived around the learning outcomes of demonstrating knowledge of design communication techniques to appropriately communicate with relevant stakeholders, use a range of communication tools; including storytelling, visual, audio and sensory techniques, to deliver creative ideas and innovative solutions and to represent designs in balanced proportion in 2D/3D which will contribute to a design portfolio. To develop these skills, the next 10 weeks are split into three teaching blocks as detailed in Tables 4-6:

- **Weeks 11 – 12:** Continued exploration of color in relation to form, through shading and texture using markers, chalk pastel and color pencils (Table 4).

- **Weeks 12 – 16:** Exploring products, form and proportion, sketch work narrative, product detailing and design narrative and dynamic expression of views (Table 5).

- **Weeks 17 – 20:** Design briefs used to develop independence and sketch competency through product interrogation, product sketches, interfaces, detailed forms, and human interaction (Table 6).

Table 4   BA Product Design sketching syllabus weeks 11 & 12 - Exploration of color and form.

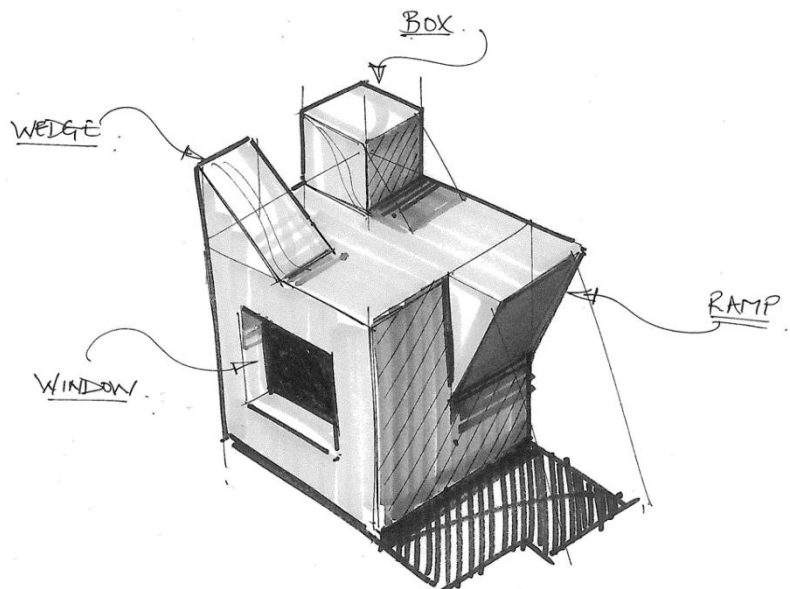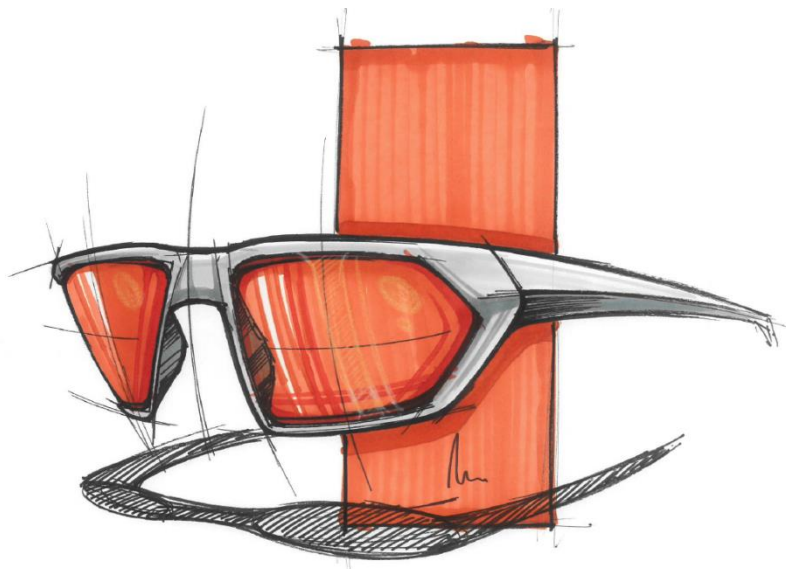| Session No.	Sketch Class Description	Exercises
11	Color and shading and its application to product sketches.	• Exploration of color in relation to form, through shading and textures using markers (Figure 5). • Rendering approaches to cylinders, cones, tubes, and their application in relation to rendering sketched products i.e. torches, bottles, and lights. • Initial exploration of chalk pastels as mid-range tones.
12	Christmas Special: geometric Christmas decorations.	• Design a Christmas themed robot 'Santa' or 'Reindeer' in geometric form. • Design of a geometric Christmas decorations through structure, geometric construction, and application of materials through color and texture.

Figure 5   Continued exploration of color in relation to form, through shading and texture using markers. (Credit: Paul Kennea)

Table 5   Weeks 13-16 exploring products, form and proportion, sketch work narrative and product detailing.

| Session No.	Sketch Class Description	Exercises
13	Transitioning forms, orientations and implications and application of color.	• Develop detailed 3D forms of DIY Tools and hand grinders. • Create a series of distinct perspective views sketched and colored using markers, pastels, and color pencils.
14	Creating nonliteral forms and engaging with freeform details.	• Understand the development process of nonliteral forms, by engaging with freeform detail creation. • Generate 15-20 sketches which explore form, proportion, and detail. Explore basic color and tonal shades and its application to quick sketches for design distinction.
15	Sketch narratives through annotation, and storyboarding.	• Understand the importance of designer handwriting, elevational and perspective forms. • Develop a range of sketches exploring a pet food packaging solution and the narrative of use. • Produce an informative and engaging sketch sheet, that takes the viewer through a product story.
16	Exploration of design narratives and dynamic expression of views.	• Sketch a pair of sunglasses in elevation to then apply in perspective orientation (Figure 6). • Apply a constructed approach to transfer design features from an elevation sketch into perspective sketch forms. • Explore mid horizon perspectives and other formats.

Figure 6   Sketch a pair of sunglasses in elevation to then apply in perspective orientation. (Credit: Richard Malcolm)

Table 6   Weeks 17-20 focus on design briefs used to develop independence and sketch competency.

Session No.	Sketch Class Description	Exercises
17	Design Brief 1 - Design four pencil sharpeners using quick ideation.	• Design a pencil sharpener that stores sharpening's utilizing the design sprint approach to produce three concepts. • Apply a critical design eye to making critical choices for three concepts thus creating direct correlation between critical design practice and design sketching. • Apply design language to create a desk mounted and handheld version of the pencil sharpener.
18	Design Brief 2 - Designing toasters exploring control interfaces.	• Exploration of control interfaces though the medium of designing toasters. • Apply structure, line weights, detail, functionality, and dynamic detail. Color, shading, and narrative are applied.
19	Design Brief 3 - DAB Radio design exploring control interfaces, textural considerations, and design aesthetics.	• Four designs exploring control interfaces, critical aesthetic content, detail proportion and textural considerations. • Explore different user demographics and iterate the designed DAB radio accordingly.
20	Design Brief 4 - Designing for users exploring detailed forms and human engagement.	• Determine the relationship between detailed forms and human engagement. • Sketch control interfaces and designed forms in elevation views before then generating perspective views. • Design briefs focus on teenagers, professionals under 40, and the over 60's retired. • Critical discussions regarding design detailing in relation to class and stereotypes (Figure 7).
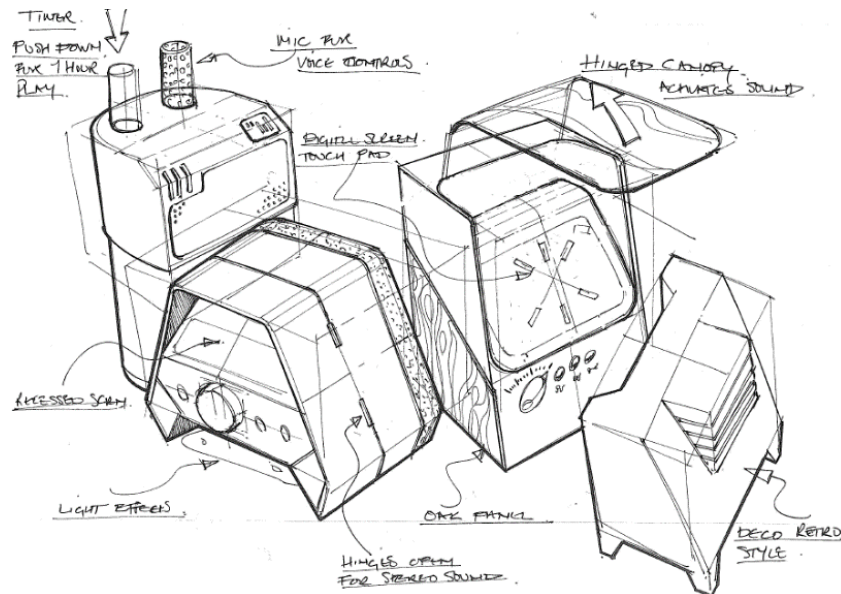
Figure 7   Exploration of control interfaces in 2D/3D form in relation to varied user demographics and stereotypes. (Credit: Paul Kennea)

5.3 Differentiating BA & BSc Product Design Sketching Syllabuses

Similar to the course-specific ten-week syllabus for BA PD, the BSc PD course has its own syllabus aligned with its learning outcomes, such as representing designs in 2D and 3D forms within portfolios and evaluating complex design solutions with conflicting constraints. A notable challenge with BSc PD students, compared to their BA PD counterparts, is the initial reluctance to sketch freely and a fear of making mistakes. Consequently, BSc PD students tend to rely on tools such as rulers, compasses, and protractors or quickly gravitate towards digital and CAD solutions. BSc PD sessions therefore focus on encouraging freehand sketching earlier, limiting the use of these tools.

While BA PD students initially concentrate on geometric objects, BSc PD students are pushed to explore more freeform objects earlier in their sketching classes. To establish a clear link between design studio sessions and sketching classes, the sketching topics include footwear, packaging, toys, furniture, and industrial products. To explore a 2D/3D view, a methodological approach to designing footwear is explored as a topic; this allows for the experimentation of color/texture and straight away prevents the use of rulers etc. By focusing on communicating panels/plan views, students can methodically construct their trainer designs in 2D and 3D (Figure 8 & 9).

Figure 8   Methodically sketching a 2D view of a Nike concept trainer (Credit: Richard Malcolm)
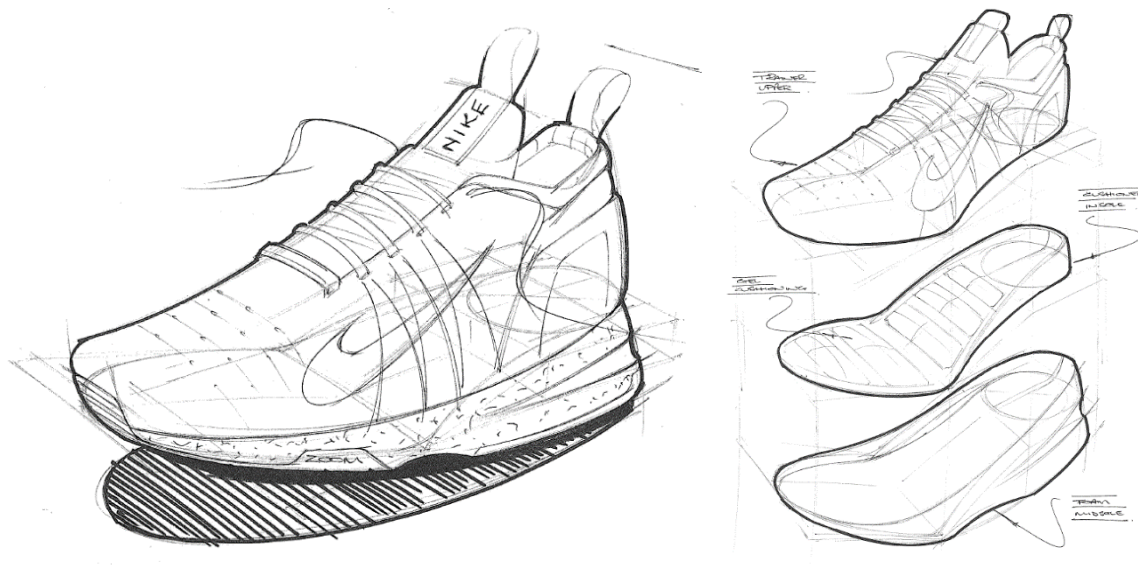
Figure 9: Methodically sketching 3D views of a Nike concept trainer (Credit: Richard Malcolm)

In the BSc PD syllabus, it's crucial to construct complex forms, explore unique perspectives, and convey ideas effectively. This involves physically examining products or conducting image studies on products such as power tools, mobile phones, chess pieces, or packaging (Figure 10 & 11). In contrast to BA PD courses, which emphasize geometry, user considerations, and aesthetics, BSc PD students go a step further. They not only create visuals, including elevation sketches and 2D/3D forms but also delve into materials, key properties, and industrial communication methods, including British Standards (BSI) symbols and technical manufacturing details. Additionally, BSc PD students employ storyboarding and design sprint techniques to teach quick ideation and effective product communication.

Figure 10 Power tools project specific sketching class exploring product detailing, sketch page composition and annotation (Credit: Richard Malcolm)

Figure 11 Mobile phone studies in perspective (Left); Materials and textures rendering for chess pieces (Right) (Credit: Allan Cutts)

The last notable difference in the sketching syllabus lies in the design briefs. BA PD briefs center on products such as toasters, DAB radios, and pencil sharpeners. In contrast, BSc PD students tackle more technically oriented products, ensuring the written communication and design language align appropriately. BSc PD students focus on briefs related to Lego/Duplo and the injection molding narrative, Bluetooth speakers, headphones, earbuds, sustainable packaging, and sheet metal packaging. While the core themes, learning objectives, and intended outcomes align between the two courses, as detailed in the weekly breakdown in Section 5.2, the key differences lie in design communication, product types, and the design language used.

5.4 Core Exploded Sketch Assignment – 4 Weeks

To conclude the first-year design sketching syllabus, student learning is evaluated through an assessed exploded sketch assignment. This assignment ensures that students can apply the comprehensive skill set developed over the initial twenty weeks to produce a single output. The exploded sketch assignment also allows students to articulate the presentation of visual and technical information in sketch form.

The assignment involves not only creating an exploded assembly drawing but also surveying a product and providing the accompanying preparatory sketches to demonstrate the methodical construction of individual components before the exploded view, illustrating how these components interrelate. Throughout the sketch exploration and production of the exploded drawing package, students must effectively use construction lines and techniques, consider plan views of components, ensure appropriate perspective in their sketches, and accurately communicate a bill of materials (BOM) with technical annotations and detailing. Critically, two new skills are taught during the exploded sketch project and these skills are the alignment of sketched components on the exploded sketch using construction techniques and the planning and delivery of sketch pages that showcase the exploded view.

The brief requires the purchase of a low-cost toy, DIY/tool, gardening, or computer product that has no less than five parts. Students disassemble/survey the product to understand the order of various parts and how they may assemble on the exploded view drawing. By separating the parts out at a distance away from their original positions, a better understanding of the finished objects, and their relationships can be gained.

The preparatory sketches guide the production of an exploded design sketch of the entire product. This presentation sheet includes a parts list, technical information/annotations (related to injection molding/materials, etc.), general dimensions, and layout clarity (Figure 12). This enables students to connect the sketching process with concurrent engineering CAD sessions held throughout the academic year.

The overall presentation of the exploded sketch pack must also demonstrate effective use of color, line weights, and design detailing. Students are assessed based on the presentation of their process, correct application of perspective, proportion and positioning, technical detailing communication and the overall presentation and composition of their work. Examples of a student submissions can be found in Figure 13 & 14.
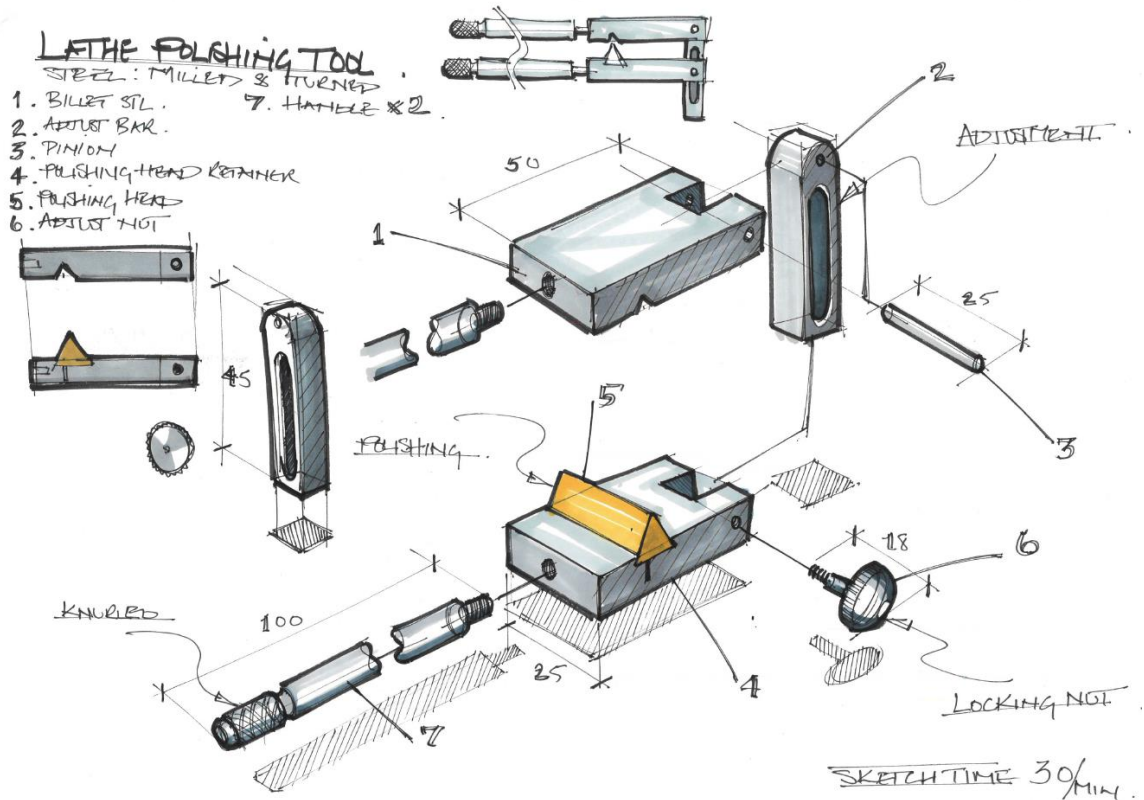
Figure 12 Example of an exploded sketch of a lathe polishing tool utilized for demonstration during design sketching classes. (Credit: Paul Kennea)
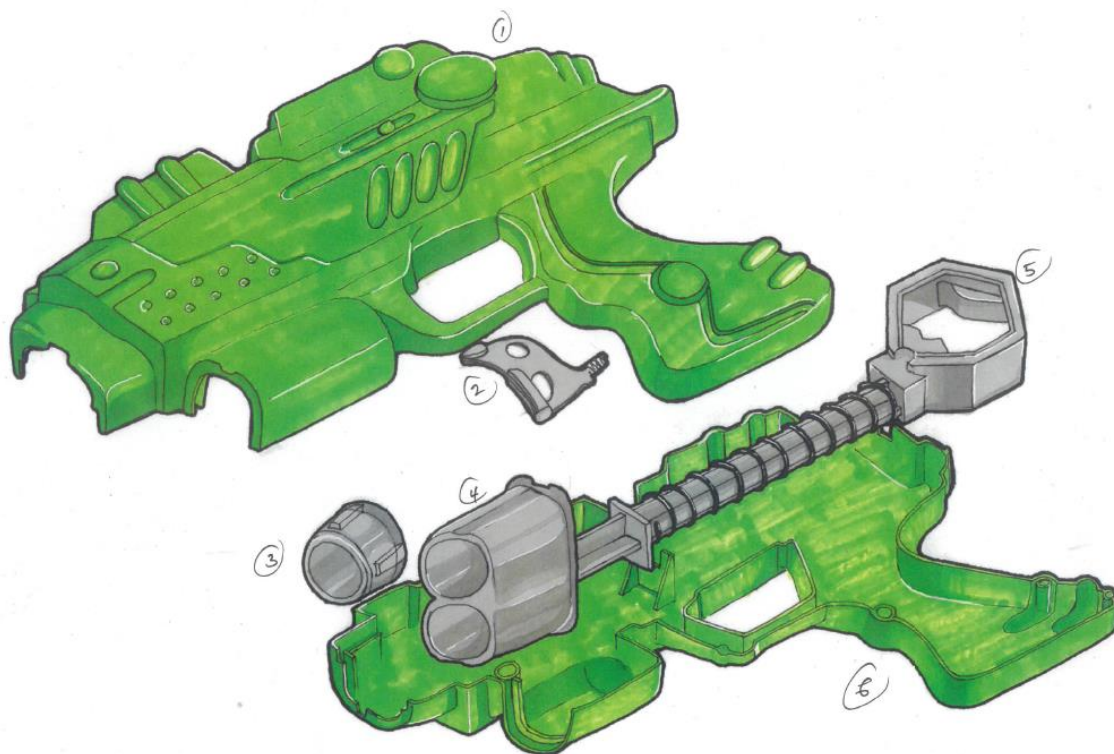

Figure 13 Example of a student submitted exploded sketch of a toy nerf gun. (Credit: Tomi Daniels)
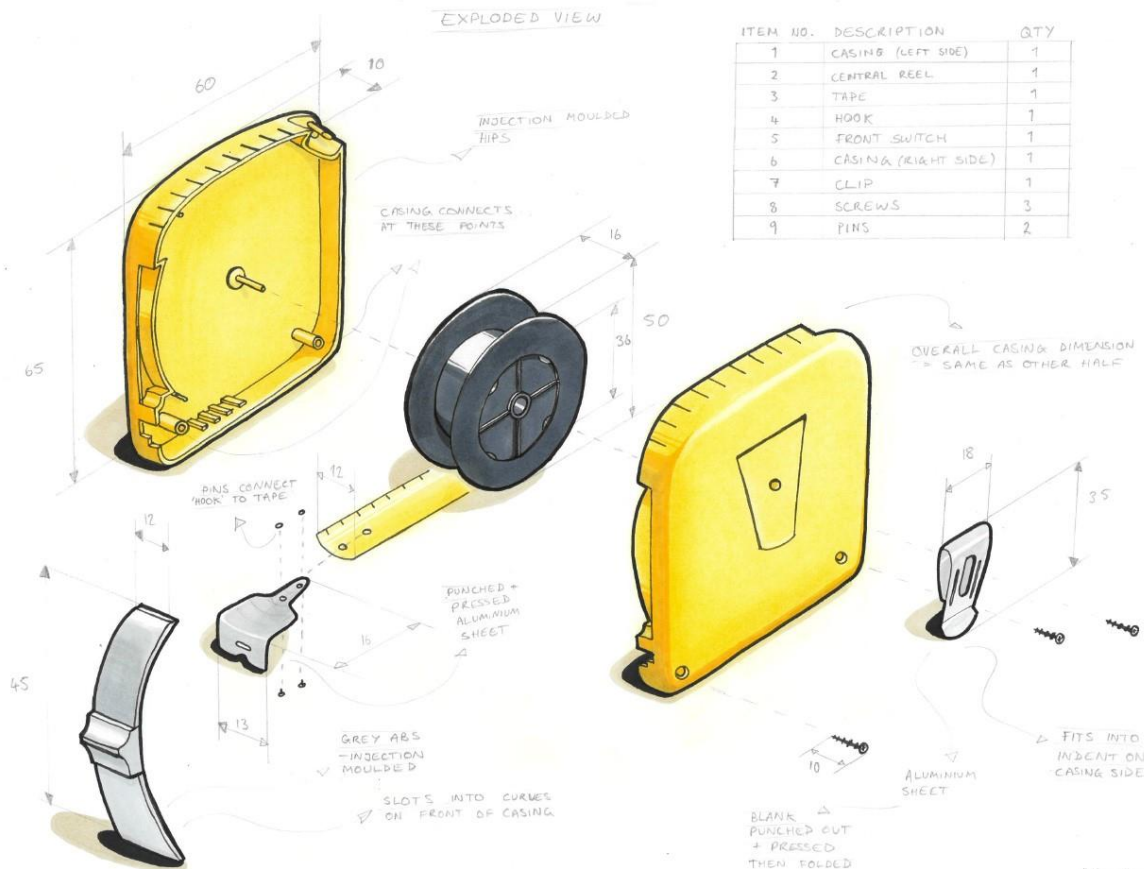
Figure 14 Example of a student submitted exploded sketch of a tape measure. (Credit: Gabriella Jones)

6. Conclusions

This paper highlights how the point of entry and early education of design students can significantly vary at the secondary level, and how recent changes in entry routes into higher education affect the student basic skill levels, particularly in design sketching. The development of the presented design sketching syllabus illustrates how overcoming initial barriers in design sketching can be achieved through structured and progressive skills development. Importantly, the syllabus emphasizes the power of the pen/pencil and cautions against pushing students towards digital alternatives too soon. Research presented shows that students themselves prefer traditional skills when given the choice early in their design education, and these fundamentals serve as a foundation for a successful transition to digital tools in the future.

A key driver behind the developed design sketching syllabuses is formulated on the principles of creating confidence, repetition of skills, reflection, the application of sketch development and the variation of activities whilst reinforcing progressive development. Course identity and relevance to industrial perspectives are also key drivers to ensure students understand the relevance and drivers behind their education.

Ensuring that design sketching skills meet industry needs is crucial. In recent years, higher education project collaborators have shifted their focus from requesting CAD outcomes to demanding high-quality sketch work, sketch modeling, and rapid sketching abilities. This change is driven by client meetings where initial discussions aim to function as live design sessions, expediting the design process. Within our academic institution, we've observed the rising demand for high-quality design sketching skills as a requirement for student placements. Students are often asked to present a project developed within one hour or in one day during interviews. Employers are interested in assessing communication quality and creativity rather than software-driven idea refinement.

The demands from prospective placement students and graduates have evolved, with a growing distinction between creative and technical roles. This has led to increased requests for timely communication of work through design sketching. Industry-sponsored academic projects have also shown this shift, as companies now prefer design sprints or short projects over extended ones. Consequently, students must produce high-quality sketch work within tight timeframes, which project collaborators use to shortlist students for potential job interviews. Therefore, the power of the pen/pencil and the associated skills are critical to a developing designers toolbox of skills.

Based on the critical context presented in section 2 and 3, and the presentation of the developed design sketching syllabuses in section 5, the power of the pen/pencil still has relevance in today's design education. The rapid growth of digital, immersive, and AI technologies has expanded options for design sketching, ideation, development, and concept visualization. However, these tools rely on the core principles of design sketching, particularly perspective, proportion, form, and construction. The most efficient approach to instilling these fundamentals is through consistent design sketching sessions, which establish the foundation for use across various mediums.

To conclude, we recommend five key points for consideration when developing design sketching sessions and syllabuses within higher education:

1. At point of entry, ensure a thorough assessment of a student's skill set is determined to allow for the syllabus content to be pitched at the correct level.

2. Weekly design sketching classes are essential to teach the fundamentals skills required to effectively communicate as a designer, whilst also instilling confidence and repetition in the skill set.

3. Although the rapid development of digital, immersive, and artificial intelligence (AI) technologies for design sketching are positive, tuition on the traditional skills is essential to provide context and design sketching fundamentals.

4. Sketching syllabuses should be taught methodically introducing skills steadily over a sustained period, thus not overwhelming students but instead giving them confidence on incremental skills development.

5. Syllabuses should be developed based on the flavor of the course being studied, thus providing relevance to the students aspiring employability/industrial aspirations.

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About the Authors:

Paul Kennea is a Senior Lecturer in Product Design who teaches vocational skills, design studio and conversations on critical design research/writing, with specialist knowledge in engineering CAD. Paul has championed for decades critical evaluative design thinking through key vocational practices.

Richard Malcolm is a Senior Lecturer in Product Design who teaches vocational skills, design studio, materials and manufacturing and 3D CAD. Richard has a passion for design sketching, design education research and secondary design and technology education.

Dr Francesco Luke Siena is a Senior Lecturer in Product Design who teaches design studio, design for manufacture, 3D printing, additive

manufacturing 3D CAD and design research. Luke has a passion for design education research, research and development, medical device design and technological applications.

Dr Joseph Stewart is a Senior Lecturer and Course Leader in BSc Product Design who teaches design practice/studio and critical design research/writing. Dr Stewart has been a Success for All Champion and is a Mental Health Champion within the Product Design Department.

Allan Cutts is an Hourly Paid Lecturer in design sketching, model making, critical design studies and design studio. Allan has a passion for furniture and product design and is a former departmental lead for design and technology within secondary education.