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EVOLVING A MODEL OF GEN-AI ENHANCED DESIGN VISUALISATION WORKFLOW

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ABSTRACT

Artificial Intelligence (AI) has been embraced in design education and practice communities, and there is now an interest in creating learning experiences which are informed by this new paradigm. Encouraged by institutional support for principled "continuous improvement" and "innovation" which could appropriately integrate AI for teaching, learning and assessment, we explored Vizcom, an AI tool that enhances sketch-based image generation and integrates with CAD and digital workflows. We wanted to understand the patterns of transition between student's past design and AI experiences into Vizcom. Our interventions took place in two Product Design modules (classes) —one undergraduate (UG) and one postgraduate (PG) —both focused on transitioning from sketches through to CAD or physical models. Vizcom was introduced in computer lab sessions, offering students exposure to emerging digital tools, and they were asked to then complete tasks related to their project work. Analysis reviewed student outputs from the dedicated Vizcom sessions, their exhibition work (from UG intervention 1), including user environment visualisation, and a survey of participants of intervention 2. Results showed that it was difficult for students to move beyond superficial experiences within short timescales, and relatively few (10/50) carried it through into their project work. Of those that did, there was evidence of integration of the tool. The survey may suggest those students less confident about their rendering skills were more likely to be impressed by Vizcom, and that there was a correlation between positive perception of Vizcom and agreement that it should be used in educational settings.

Keywords: Vizcom, visualisation, Gen-AI, generative AI

1 INTRODUCTION

With increasingly fast evolution of generative AI (Gen-AI) design tools, their integration into teaching practices has become a growing area of research interest in engineering and product design education. So far, studies have focused on ideation, automating visualisation and design process efficiency. The authors have remits to evolve pedagogy focused on transitions through ideation, CAD and visualisation and the preceding conference in this series inspired with many citations of the software Vizcom; there was immediate opportunity referencing our curriculum. Teachers and students are hesitant to 'unleash' AI in the classroom [1], but recent studies report 50% [2] of students are regularly using it with little intention to cheat [3] and wanting to ensure propriety; educators need to guide practical and ethical use. Supporting, the university principles for Gen-AI use in learning, teaching and assessment encourage "innovation," "continuous improvement" where "equity and fairness," "being people orientated," "transparency," "security," "ethics" and "sustainability" are ensured. This work aims to develop insight informing continuous improvement by exploring Vizcom applications within current curricula, classes and projects, most specifically for product form visualisation. How will student designer workflow modify to integrate Vizcom and tools like it? To start, design education focused literature review was completed. 2 modules (classes) were identified having relevant outcomes and flexible computer lab time designated for introducing students to new tools. The first intervention was in Semester 1 within 'Design Emotion and Experience', a longstanding (since 2010) undergraduate (UG) year 3 (out of 4 or 5) Industrial Design module. BSc Product Design students design a loudspeaker product form inspired by human emotion, culminating in an exhibition of prototypes (Figure 1(c)), surface CAD models, design journals and six A3 wall sheets. The brief is well-received and used repeatedly. New this year, to encourage detail, and a focus on design with sustainable purpose, students were required to source a recycled loudspeaker driver (figure 1(a)) as the basis for their designs.

(a) (b) (c)

Figure 1. (a) Recycled loudspeaker drivers (b) Neil Shepherd's Fiesta Speaker (c) Excerpts of student exhibition

Intervention 2 was in the postgraduate (PG) semester 2 Product Modelling and Visualisation module which has in recent years had quite radical content development through integrating new research informed VR and CAD technologies and the associated principles/process [15]; the assignment in the class requires students to survey a broad range of visualisation tools to support their product development process; Vizcom fits.

2 REVIEWS OF LITERATURE

2.1 GenAI in Design Education

Systematic review of AI in design education categorised design: representation (to enhance outcomes' presentation); deduction (supporting teaching) and acquisition (supporting design process) [6]. For representation, studies demonstrate increasing idea novelty and diversity [7] within accelerated time frames [8,9] form AI-assisted design. Automation of repetitive tasks helped students explore more unconventional aesthetics and refine these with precision [8]. These significant advantages inspire beyond conventional approaches [9]; AI can be an interactive co-creator with students (Figure 2).

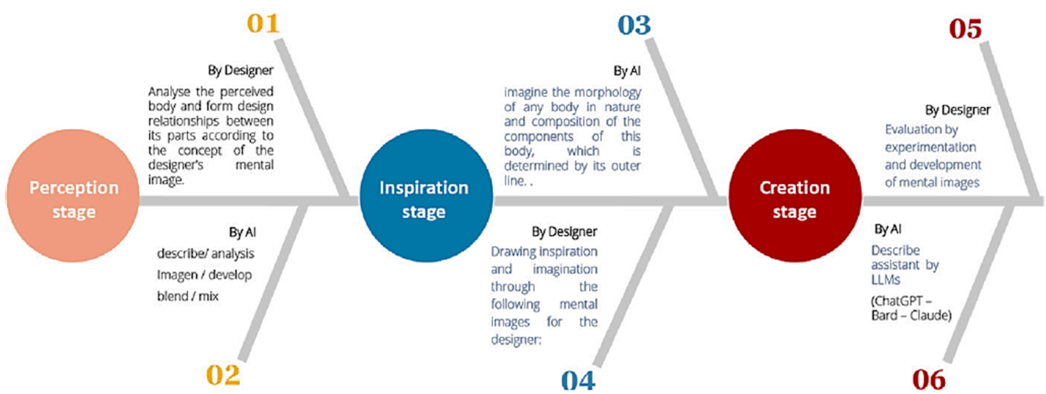

Figure 2. Hashem and Hakeem's [8] 3 stage model of AI supported design

2.2 Vizcom in literature

Impact of text-to-image generation software in design has already been examined [10] suggesting that currently available tools may support designers in ideation but that consistency and adherence to design specifications must be questioned. Emerging tools go beyond text-to-image; Vizcom transforms hand-drawn sketches into photorealistic rendered images using genAI streamlining concept workflows. Designers have the same control over their sketches and able to manipulate, edit or re-generate certain areas and layers of rendered outputs. 3D models can be generated, viewed, then exported to CAD.

Vizcom has already been explored in design education, for enhancing creativity and sustainability, facilitating co-design, and improving concept visualisation [7, 11, 13]. Classroom experiments highlight examples of students assessing environmental impact factors, by integrating AI-driven optimisation for considerations such as material efficiency, energy use, and recyclability [7]. Demonstrating enablement of more inclusive co-design approaches, Vizcom improved clarity and communicability of sketches produced by non-designers increasing opportunity for user feedback [11]. Conversely students' Vizcom-generated renderings were evaluated for improved understanding over traditional sketching, and whilst realism was noted, it did not significantly outperform in overall comprehension [13]. Common to the examples is the intuitive interface, a relevant factor for integration into design education [7, 11]. Observed unintended modifications of ideas suggested that foundational sketching skills still remain essential for design communication, and principles for best Vizcom results are emerging [5], These insights reinforce the idea that AI tools should be integrated as complementary to design process with human oversight ensuring complete and thoughtful design [13].

2.3 Challenges identified for integration of AI in Design Education

There is limited empirical evidence linking AI-driven teaching to improved learning outcome attainment and therefore further design education research is needed [6]. Despite AI benefits, student concerns remain over negative impact on creativity, algorithmic bias, ethical implications, plagiarism, low cognitive load and over reliance for decision making [7, 12]. AI-generated designs have reflected biases in training data; standardised designs overrepresenting western-centric aesthetics [9] restricting creative exploration and reinforcing stereotypes. AI models are often trained on copyrighted materials so students may unknowingly submit work containing unauthorised and IPR infringing elements [9,14]. As highlighted in literature [8], educational institutions play a vital role in ensuring AI does not replace human creativity, that access to AI is equitable, in fostering critical thinking and ethical awareness, and equipping students and educators with skills to navigate AI responsibly. Providing this balance, design education can harness AI's potential while maintaining originality and integrity [12,14].

3 INTERVENTION 1 – DESIGN EMOTION EXPERIENCE (UG)

Figure 3. Overview of Vizcom Scene Development task

The Vizcom trial appended existing tutorials on graphical composition and exhibition sheet layout. Students (N=40) attend for 3 hours in a computer lab guided through layout software and graphic design principles. One of the A3 exhibition sheets must display a rendered product CAD model in a contextual user 'scene'. In previous years students often use stock images, not always demonstrating strong compositional ownership. We saw an opportunity for Vizcom to bring more control over students' visualisations. Vizcom was introduced in the last hour of the class stating that any use of the software in projects must be documented in the design journals. Each student was given a perspective grid template (figure 3) and a sharpie pen to aid quick composition and asked to upload the room scenes they generated, along with sources sketches, prompt terms and the % of drawing influenced to a shared document. 2 examples are shown above in figure 3, and a further 10 students utilised Vizcom within their final submission documenting how it had either been used in concept development or in the page user scene development.

Figure 4. Student outputs – bespoke background scene renders from Vizcom and evolution of sketch to product form

Figure 4 shows 2 exhibition sheets for which the students acknowledge a role for Vizcom. These potentially fitted the emotional and experiential theme they had conceived better than a 'found' image. The record shop is familiar but also unusual where the cover art does not relate to real releases and the shelves also include stacks of unknown media; these quirks of AI worked for the student's psychedelic theme. The figure also shows a sketch and visualisation from the class session that the student evolved into their final prototype submission. Use of a perspective sketching in green sharpie pen was interpreted by Vizcom into a thinner 'bent wire' construction may have influenced the finer edging detail and green palette of the final work.

Figure 5 shows a fuller Vizcom processes captured in a design journal; the software used to move through 2 concept iterations and, after settling on a form, the student replicates the design manually in CAD returning to Vizcom for trial rendering of the final model.

With N=40 in the class, and only 10 demonstrating use of the AI software within their process, the intervention session certainly didn't 'open the floodgates'. This may have been as there was complexity created around caveats of use, but also that the intervention happened in week 8 of an 11-week semester and to maximise results, beyond superficial, requires skill development.

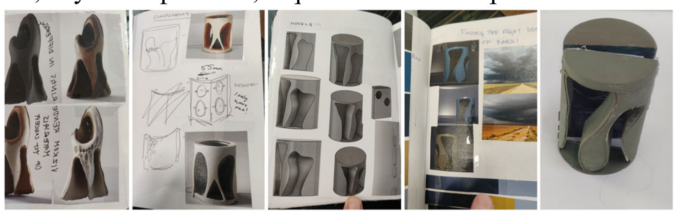

Figure 5. A Vizcom Workflow captured in a student's journal and final design

4 INTERVENTION 2 – PRODUCT MODELLING AND VISULISATION (PG/UG)

The 2 hour Vizcom session with the postgraduate/senior UG student class was structured as: **15 mins** Register all on Vizcom workspace, introduce Gen-AI concepts/principles in parallel; **10 mins** Warm-up activity: Gen-AI bingo [16]; **15 mins** introduce Vizcom with examples of key functionality and student outputs from intervention 1; **20 Mins** Vizcom Activity 1 – render Porsche concept sketch; **20 mins** Vizcom activity 2 – sketch concepts for class project and upload to Vizcom for generation and enhancement (see figure 6) **20 mins** Vizcom Activity 3 – advanced render and editing technique based on coffee machine sketch. We issued a link to the participant survey with 30 mins remaining.

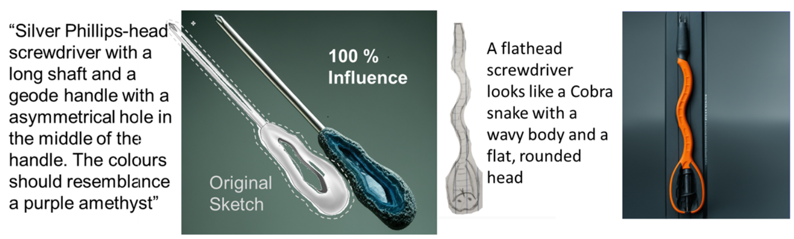

Figure 6. Vizcom Output Examples from Intervention 2

4.1 Survey design

The survey was designed to be low effort to complete, structured aiming to generate insight patterns around: **Students profile (10 items)** – course of study, level of study, first degree if relevant, rating 7 design and computing skills on a 5-point scale, level of industry experience. **Current AI Use (3 items)**, **Reflection on Vizcom (6 items)**, **Opinion on application and potential impact of Vizcom/AI (6 items)**. The last section was focused on **Concerns about Vizcom and the trajectory of AI tool development it represents (7 items)**. 66 students are registered as attending the session and engaging with the shared Vizcom workspace, 35 completed the survey (N=35).

4.2 Survey Results

Figure 7. shows all survey items with the exception of 'course of study.' An abbreviated correlation matrix highlights potential associations, their strength and significance based on a Spearman Rank Correlation Coefficient. Descriptive quantifications of responses made using the two 5-point scales are also included as visual overviews. Items 2-8 used a competency scale ranging from 1. "little competency" through "below/above/average" to 5. "masterful." Items 10-31 all used the same 1. "strongly disagree" to 5. "strongly agree" scale.

4.2.1 Student Profile

20 of 35 respondents were senior UG Product Design students. There were 8 Mechatronics and 6 Product Design Postgraduate (PG) MSc students, and mechanical engineering was the most common first degree. It was more relevant to investigate the influence of UG vs PG as this also mapped to more or less sustained design experience over the last 4 years. From figure 7 there was negative, weak, association between level of study and how respondents rated their relative rendering competency (r=-.368*); PG students were more likely to rate their render skills lower; a reflection of their more fundamental engineering background. 6 members of the PG group had worked as graduates, but the majority of the sample claimed little work experience overall. There is a potential negative association (r=-.349*) between level of study and the concern of AI growth leading to a reduction of Job Availability (30) suggesting that UG students were slightly more likely to express this concern.

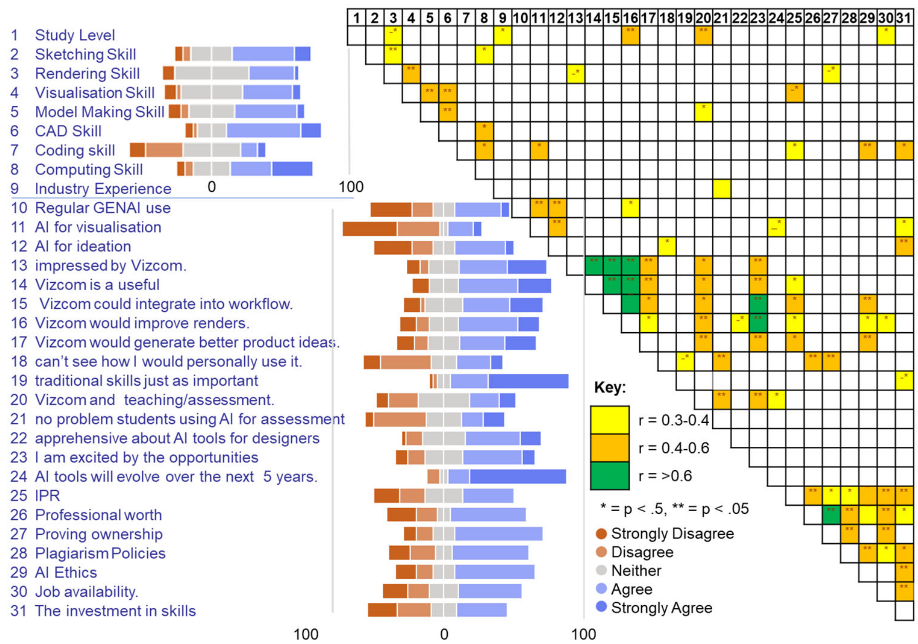

Figure 7. Survey Results including visual descriptive results and abbreviated Spearman correlation matrix analysis

4.2.2 Role of Skill Confidence

Whilst there are associations between ratings for the different skills in items 2-8. Sketching, CAD and Model Making are where there is most confidence overall, but there is relatively little association between this confidence and how the rest of the survey has been answered. Of note, a negative correlation (r=-.353*) between rendering skills and whether the student was impressed by Vizcom; those with lower confidence in rendering perhaps more likely to be impressed by basic ideas of Vizcom. There was also a negative correlation (r=-.441*) between visualisation (graphic design) skill confidence and concern for Intellectual Property Rights around AI generated content. This perhaps only confirms those with lower confidence valuing their work less, rather than a more carefree attitude to AI.
There is notable lack of confidence/experience in coding overall, but confidence in coding is moderately positively correlated with having past experience of use of AI for visualisation (r=.410*).
As can be seen under item 10, those using Gen-AI tools as part of their practice was fairly evenly split between those who don't and do regularly use it. Of those that do use regularly there was a correlation with use for visualisation (r=.433**) and ideation (r=.509**). Regular users were more likely to agree with item (16) that Vizcom would improve their rendering (r=.382*) but no association with a belief that it would create better ideas (17). No other pattern emerged in the responses of low or high AI users.
Items 13-18 responses show positivity around the Vizcom software, the potential application and usefulness. A number of these survey items correlate quite highly together, and to the same items; there may have been an opportunity to probe deeper or more broadly. Agreement with these items seems to correlate with agreement that (20) Vizcom should be used in teaching and assessment at university. The intervention did seem well received and we were literally using Vizcom in teaching, an obvious result?

5 CONCLUSIONS

As survey item 24 suggests, although Vizcom is a current pinnacle of design Gen-AI, more significant developments are likely coming. Teaching and assessment involving CAD tools have had a long period of maturation, and university pedagogy and learning outcomes are agnostic of software. Tools like Vizcom likely change practice and therefore what we teach and how we assess in design focused higher education. Universities may more regularly be updating tools and principles which deal with the concerns outlined in the paper; learning outcomes must be re-evaluated. Our trials gave confidence that we would not lose control of assessment of design work through AI and that the true possibilities of the software only become realised when the designer has a well-defined process and clear intention.

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