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Integrating Generative Artificial Intelligence Across the Curriculum in Higher Education: Multi-Disciplinary Case Studies

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ABSTRACT

Generative Artificial Intelligence (GenAI) has transformed how higher education is provided and is rapidly changing students' engagement with learning resources. As academics adopt these tools in classrooms to provide insightful lessons and scalable solutions that enhance educational outcomes across disciplines this study draws on the Technological Pedagogical Content Knowledge (TPACK) framework to explore the types of knowledge teachers require to use GenAI tools in their teaching effectively. This paper reports on five case studies from an Australian higher education institution examining the integration of GenAI across various academic disciplines. These case studies demonstrate the evolving role of teachers on teaching methodologies to create innovative educational experiences using GenAI. Throughout these diverse case studies, we show how GenAI tools can be used to enhance academic skills, critical thinking, and address pedagogical challenges. Each case study reveals the complexities and potentials of GenAI in different educational settings, including the development of critical thinking skills and understanding GenAI's limitations. The case studies highlight how teachers use the TPACK framework as a lens to assess and integrate GenAI tools in ways that support meaningful learning aligned with their content areas and instructional strategies.

Keywords: Gen-AI, Higher Education, Case Study

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1 INTRODUCTION

Higher education institutions have long been on a trajectory of embracing technology to enhance their teaching methodologies (Bond et al., 2024). The onset of the COVID-19 pandemic further accelerated this trend, pushing universities worldwide to swiftly pivot to remote learning solutions (Sum & Oancea, 2022). Overnight, lecture halls transformed into virtual classrooms, and educators scrambled to adapt their teaching methods to the constraints of social distancing measures (Panakaje et al., 2024; Simon et al., 2022).

Amidst this upheaval, the emergence of Generative Artificial Intelligence (GenAI), launched in November 2022, introduced a new and unfamiliar direction for the future of education. Educators seized upon Gen-AI tools to personalise learning experiences and automate routine tasks, freeing up valuable time for more interactive and engaging teaching practices (Yusuf, Pervin & Román-González, 2024). As academics explored these modern technologies, they discovered innovative ways to tailor lessons to individual student needs, leveraging AI-driven insights to track progress and dynamically adapt content (Farrelly & Baker, 2023; Dwivedi et al., 2023; Bates et al., 2020).

At the same time, higher education institutions have grown increasingly concerned about the use of GenAI in educational activities and assessments, fearing it may encourage academic misconduct and diminish students' critical thinking skills (Duah & McGivern, 2024; Mahmud, 2024). Alongside the excitement of technological advancement, questions and concerns have emerged.

The integration of GenAI raised ethical considerations about the impact on traditional teaching roles and the potential for exacerbating educational inequalities (Chan & Hu, 2023), leading to ethical challenges of GenAI in education that need to be identified and introduced to teachers and students (Akgun & Greenhow, 2022). While some embraced GenAI as a transformative force for educational equity and efficiency (Roshanaei, Oliverares & Lopez, 2023), others urged caution, advocating for comprehensive policies and ethical frameworks to guide its responsible deployment in higher education settings (Chan, 2023).

Albeit students have a positive attitude towards the use of GenAI in higher education, as they recognise the potential for personalised learning support, writing and brainstorming assistance, rewriting paragraphs, and research and analysis capabilities. However, they also express concerns about accuracy, privacy, ethical issues, and the impact on personal development, career prospects, and societal values (Chan, 2023; Akgun & Greenhow, 2022).

There are many perspectives on using GenAI in higher education, and there are many different practices adopted in using GenAI in classrooms. However, these practices are still in the early stages and need validation and research to understand their effectiveness. There are some guiding principles for adopting these technologies in teaching (Tertiary Education Quality and Standards Agency [TEQSA], 2024), however, there is still a great deal of anxiety among teachers about what these technologies mean for teacher practice, teacher education, and student learning (Mishra, Warr & Islam, 2023; Beckingham et al., 2024).

Recommendations provided by the Tertiary Education Quality and Standards Agency (TEQSA) include that higher education institutions should integrate GenAI literacy into student and staff training, and that higher education providers must continuously review and adapt assessment methods (TEQSA report, 2024). ChatGPT currently has 180 million users (Duarte, 2024), and to address the nature of GenAI technologies and provide guidance to teachers and teacher educators on their productive use for teaching and learning, this study explores GenAI's multiple uses in higher education through five diverse case studies reported from an Australian university, relating them to the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) to understand nuanced approaches to using GenAI technology in the classroom.

The study emphasises GenAI's role across various disciplines and levels of education, highlighting distinctive features and unique insights for educators, and how Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) are influenced within the broader context of context-specific knowledge (XK). By doing so, we aim to:

- Explore the integration of GenAI in diverse educational contexts and its impact on teaching and assessment methodologies.

- Analyze the benefits and challenges associated with incorporating GenAI into higher education across different disciplines.

- Provide insights into how GenAI can enhance learning experience and prepare students for future professional environments.

In the following sections, we present our research methodology and five case studies of GenAI in higher education. The case studies include the use of GenAI for graphic design assessment, cognitive learning strategies, problem-based learning, financial statement analysis, social media campaigns, and research skills, and demonstrate how GenAI can support student engagement, motivation, collaboration, and skill development through the lens of TPACK framework.

2 RESEARCH METHODOLOGY

GenAI is a form of digital technology and is a subset of AI developed on Large Language Models (LLMs). To understand and explore the integration of GenAI and its impact on teaching and assessment methodologies, we employed the TPACK framework (Mishra & Koehler, 2006), which posits that educators require specific types of knowledge to effectively and creatively incorporate technology into their teaching practices.

There are three key reasons for choosing this framework for our study. First, the TPACK framework enables a comprehensive approach by examining the intersection of TK, PK, and CK. Given the complex nature of integrating GenAI into educational contexts, where teachers are still very apprehensive, TPACK provides a balanced view of how technology like GenAI affects not only content delivery but also pedagogy and student interaction (Mishra & Koehler, 2006). By framing our study within this model, we analyse how GenAI reshapes teaching strategies across disciplines, ensuring that technology is not used in isolation but in harmony with subject matter and pedagogy.

The second reason is that the TPACK framework is adaptable across a wide range of academic disciplines (Herring et al., 2016; Lee & Kim, 2014), making it particularly suited to our multidisciplinary case study approach. Each discipline has unique pedagogical needs and content requirements, and TPACK allows us to explore how GenAI can be customised and used effectively in different educational contexts. This flexibility is critical for understanding the distinct challenges and benefits of GenAI in areas as varied as the humanities, business, engineering, and the sciences. The third reason is that it has been widely used in higher education research, particularly in studies focused on educational technology (Maor, 2017; Benson & Ward 2013).

The TPACK framework operates within the domain of contextual knowledge and focuses on TK, CK, and PK. The overlap of TK and PK is called Technological Pedagogical Knowledge (TPK), the overlap of CK and TK is called Technological Content Knowledge (TCK), and the overlap of TK, PK, and CK is TPACK. For each case study, we examine how integrating GenAI into teaching practices has impacted TK, CK, PK, and overall TPACK. To effectively use GenAI in educational settings, academics must possess a solid understanding of the technology and be able to integrate this knowledge with both TPK and TCK, driving strategies with expertise. The case studies reported in this paper present unique, innovative, and underexplored scenarios, making a significant contribution to the use of GenAI in classroom settings (Australian Education Research Organisation, 2024; Ivanov, 2024).

3 CASE STUDY 1: ADAPTING GRAPHIC DESIGN ASSESSMENT USING GEN-AI

This case study examines how GenAI tools were integrated into a first-year undergraduate *Visual Design Fundamentals* unit, exploring how LLMs like Adobe Firefly impact teaching and learning in visual design. Matthews et al. (2023) found that educators in this field are focused on adapting to rapid AI advancements, leaving limited time for research. The review highlighted three key themes: the automation of graphic design, the changing role of human designers due to AI, and the rise of online communities for amateur designers. The first theme, automation, poses the most significant challenge for educators aiming to keep learning resources relevant while fostering formative, experiential assessments.

In this unit, CK encompasses visual design principles, including historical movements, abstraction, and more advanced topics like colour harmony and typography. The pedagogy centers on experiential learning, allowing students to practice these principles. The rapid development of AI, especially GenAI tools that can generate designs from text prompts, introduces both challenges and opportunities. While these tools threaten traditional manual skills, they also provide new ways to explore design genres and histories.

The educator's approach to integrating GenAI tools was guided by three criteria: maintaining traditional methods, extending exercises with AI components, and fully integrating AI into the design process. This gradual introduction aligns with the TPACK framework, ensuring that technology enhances rather than overshadows pedagogy. By prohibiting the use of AI in early exercises to prevent superficial learning, the educator ensured that students first mastered fundamental design skills. TPACK in this case is demonstrated by the thoughtful integration of technology into the curriculum, balancing AI-driven methods with traditional practices to create a meaningful learning experience that prepares students for the evolving field of visual design.

3.1 Portfolio design exercises 1 using GenAI

For Portfolio Design exercise 1, students explored several historical design movements that provided historical context for contemporary design. The goal was to promote deep learning of visual design principles, which is both appropriate and effective for graphic design education (Ellmers, Foley & Bennett, 2008). These exercises differed from later ones in that they did not represent authentic design objects. Rather, they exemplified the concept of abstraction-working with a controlled subset of possibilities-which is an important theme throughout the unit. Teaching design skills requires the initial exercises to be non-representative in nature to help students focus on purely visual design relationships rather than on symbolic meaning.

Their designs were to be built up from a collection of predefined shapes provided in an Illustrator file. Students could delete, duplicate, move, rotate, colour, and transform the supplied shapes but could not create shapes freely. The second portfolio exercise focused on the application of Gestalt design principles (Koffka, 1935) to explore variety in designed objects. Students were again provided with predetermined shapes as a starting point and were asked to build two contrasting designs from them: one stable and established, the other fun and dynamic.

The Firefly LLM created vector art from text descriptions, and while reference images could be used to impart styles and objects, there was no way to instruct Firefly to create non-representational designs from supplied building blocks according to the arbitrary rules of the assessment tasks. Although the LLM posed a “threat” to the relevance of these initial exercises, it could also be a tool to further explore their themes. The illustration in Figure 1 shows what Illustrator produced when prompted to generate the sort of images required by these exercises-necessarily without the requirement to start with any predefined shapes.

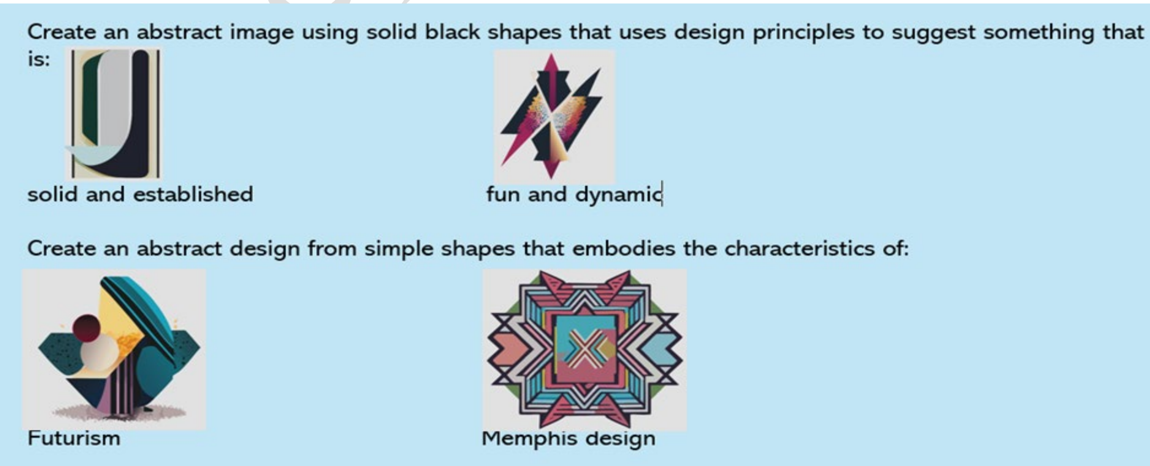


Figure 1. Analogous exercises carried out using simple text prompts.

These results show some semblance of “understanding” of design principles and genres. Given the rapidity of technological development in this area, the results above are sufficient to demonstrate proof of concept. It may be assumed that after a few more upgrades, the results achievable by the Firefly LLM would be much closer to the skill and knowledge level of a student in the unit.

3.2 Portfolio design exercises 2

The second section involved more complex tasks, developing specific skills in composition, color harmony, illustration, and typography, using Adobe Illustrator and Photoshop techniques. Figure 2 is an example of student responses to an illustration task that required them to work with a limited number of values and color swatches, and with a defined color harmony.

Figure 2. An example of a design portfolio exercise from the portfolio exercise 2 of Visual Design Fundamentals

Firefly can produce work following the same requirements. While it is not polished, it is close. In theory, a student could begin this exercise using a prompt and then edit the result to correct the evident glitches, achieving a quality result in much less time. The integration of the Firefly LLM's generative vector art potentially revolutionises the work of the graphic designer and calls into question the relevance of much of the technical content of a unit in the medium term, as illustrated by these tasks.

While the degree of traditional illustrative technique used by the student did not necessarily make the finished illustration better or worse, it may be that, during the learning process, skipping the traditional "hand-made" approach could lead to a shallower form of learning, producing students whose choices of colour harmony and degree of abstraction become much less deliberate and grounded. For that reason, it was decided not to allow students to use LLM techniques for this exercise but to supplement it with additional practical material to help students modify and improve GenAI generated illustrations, as that is likely to be a useful skill as LLM mediated workflows become more mainstream.

4 CASE STUDY 2: APPLYING AI IMAGE GENERATION TO A NATIONAL SOCIAL MEDIA CAMPAIGN

This case study explores three events in late 2023: the "red teaming" of DALL·E 2, the release of OpenAI's DALL·E 3 plugin for ChatGPT-4, and a social media campaign tied to the Australian Indigenous Voice Referendum. Experiments with AI image generation during this period, using temporarily relaxed safety measures, offered insights into handling cultural bias. The study aligns with TPACK by integrating CK (cultural representation and bias in AI), PK (teaching critical assessment of technology), and TK (using tools like DALL·E, Procreate, and Canva for generating, editing, and distributing content).

4.1 Sketched outline of the emergence of machine visual learning and OpenAI's DALL·E

Key sources of training datasets for machine visual learning (MVL) systems in the period 2006-2017 were: ImageNet, Flickr, Google Image Search, YouTube, and government agencies like the FBI (Crawford, 2021). Of those sources, the ImageNet Large Scale Visual Recognition Challenge, held annually from 2010 to 2017, made a major contribution to the development of the field (Russakovsky et al., 2014). Inspired by and building on the ontological and lexical power of the 1990s WordNet project (Miller et al., 1993), turn-of-the-century generative visual models (Fei-Fei et al., 2004), and a huge dataset of images manually annotated using the "artificial intelligence" of crowd-sourced labour by Amazon Mechanical Turk (Crawford, 2021, p. 63), the challenge invited participants to train their MVL algorithms. An evaluation server would comparatively score the automatically annotated training image results against the manual set. The successive iterations of the challenge led to numerous innovative tech start-ups, breakthroughs in object recognition, and significant machine learning advances, including developments in neural networks and diffusion models (Fei-Fei & Dang, 2017).

In 2015, OpenAI was launched and proposed the development projects ChatGPT and DALL·E. After a four-year gestation, GPT-2:1.5B, a simple text generator capable of predicting a user's next input, was released in 2019. DALL·E is a diffusion model trained on images that have been completely distorted with random pixels. The model has learned to convert these images back to their original form. An innovative version of zero-shot learning was incorporated into the experimental DALL·E in 2021. Zero-shot learning is where the learning system observes samples from classes that were not provided during training and predicts the class they belong to. Called Contrastive Language–Image Pre-Training (CLIP), it adds a level that interprets images and assigns text to them as a kind of reverse-engineering process check.

By 2022, DALL·E 2 was using CLIP at its core (Miszuck, 2023), while also experimenting with additional processes and alternatives (Ramesh et al., 2022). DALL·E 3 was released in September 2023 with little documentation, except for a paper on the OpenAI website (Betker et al., n.d.). While the OpenAI developers claim that CLIP can conduct a range of image classification tasks, they are also aware of the social biases inherent in the model (Radford et al., 2021). Crawford says, "The AI industry has traditionally understood the problem of bias as though it is a bug to be fixed." However, it is a problem concerning "the mechanics of knowledge construction itself" (2021, pp. 130-131). Bias echoes across history and exists long before data is collected. The main challenges to mitigating bias are unknown unknowns, imperfect processes, lack of social context, and lack of agreement on definitions of fairness (Hao, 2019).

4.2 DALL·E 2 experiments from the Antipodean 'unknown'

From mid-2022, a Facebook-based group dedicated to sharing images that pushed the prompting limits of early DALL·E 2 beta releases resulted in the offer of credits in return for feedback. Divergent genres, themes, and styles were explored. Apparently, the system was blind to realistic visualisations of the Australian boomerang or the didgeridoo, also known as the traditional Yolngu Yidaki. Possibly a case of Hao's unknown unknowns (Hao, 2019)?

Experiments were conducted to explore the possibility of teaching DALL·E how a person plays the didgeridoo. While exploring biases within AI-generated imagery, a significant observation was made regarding the depiction of Australian First Nations people. Specifically, when using text prompts intended to generate images of proud-looking Australian First Nations individuals, the resulting representations often displayed facial characteristics and attire typically associated with North American, South American, or Asian populations. This discrepancy highlighted a broader issue of cultural misrepresentation in AI-generated content.

A report to OpenAI addressing these concerns and providing feedback on the observed biases in the AI's image generation was submitted. OpenAI acknowledged receipt of this report via email. It is important to note that while the report was acknowledged, there is no implication that the author's feedback directly influenced changes in the training or development of OpenAI's language model.

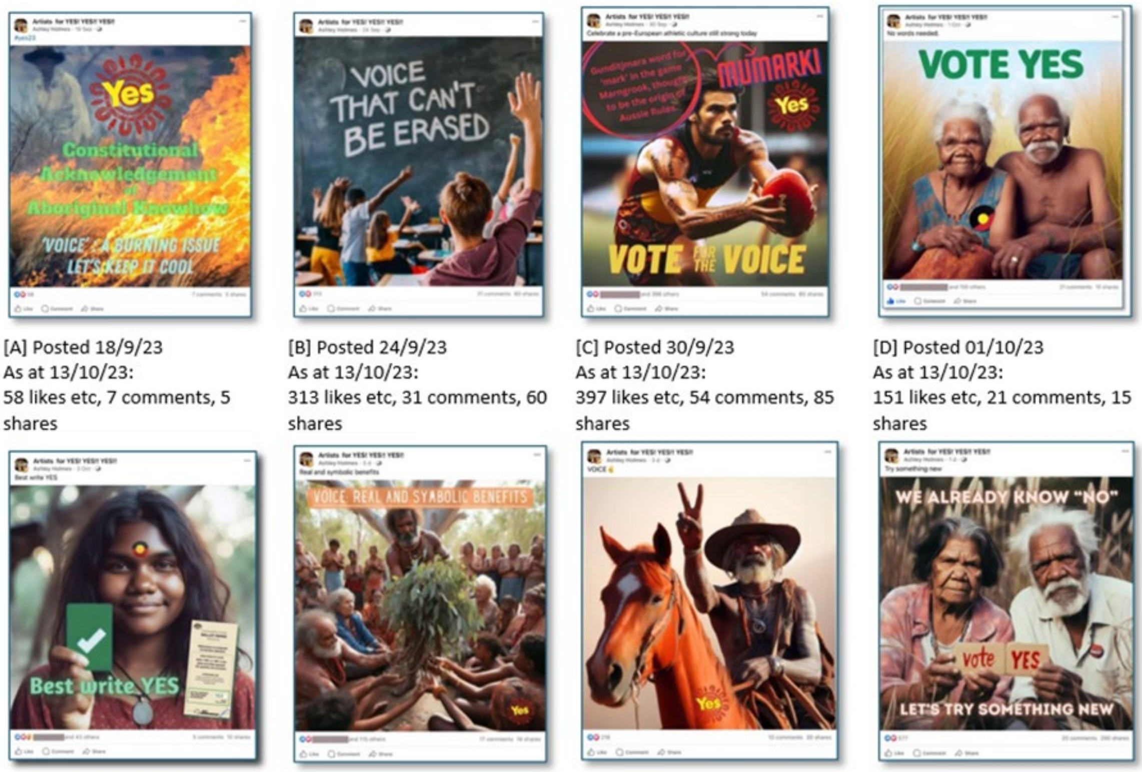
In early September 2023, OpenAI released DALL·E 3, which allowed users to interact with DALL·E 3 through ChatGPT, creating a seamless experience that appeared to bridge the two systems. This innovative approach demonstrated the potential for combining language models with generative image models to enhance user experience and creativity.

4.3 Choice of "Artists for Yes! Yes!! Yes!!!" Facebook group for a trial

In the lead-up to the Australian constitutional referendum, a live trial was conducted using AI-generated images to influence social media discourse. The Facebook group "Artists for Yes! Yes!! Yes!!!" was selected for its broad acceptance of artistic posts supporting the "Yes" campaign. Experiments used two Australian-origin platforms, Canva (Gilchrist, 2020) and Procreate (Apple, n.d.), along with ChatGPT's DALL·E plugin for image generation. Procreate was used for editing and compositing images, while Canva was employed for adding text and distributing content to social media. The trial explored how GenAI could engage users and shape conversations in a politically charged context.

The AI-generated characterisations are to be interpreted strictly in terms of achieving high veracity, novelty, and memorability (Jensen et al., 2023). This pertains to the believability of the characters represented-something akin to maintaining the fourth wall in cinema or theatre. It is acknowledged that, to only a very limited degree, this can be ascertained by Facebook public metrics in terms of likes, comments, and shares. This image and text data are presented in association with the visual samples shown in Figure 3.

The examples of posts from the campaign, as shown in Figure 3, depict that all except [B] were chosen because they include convincing representations of Australian First Nations people. Example [B] is included because, significantly for the time, the text on the blackboard in the image resulted from the prompt (with one minor edit required), which was a significant milestone in image GenAI development. Although the Facebook public metrics shown in Figure 3 are obviously basic indicators, some significant comments can be made.



[A] Posted 18/9/23
As at 13/10/23:
58 likes etc, 7 comments, 5 shares

[B] Posted 24/9/23
As at 13/10/23:
313 likes etc, 31 comments, 60 shares

[C] Posted 30/9/23
As at 13/10/23:
397 likes etc, 54 comments, 85 shares

[D] Posted 01/10/23
As at 13/10/23:
151 likes etc, 21 comments, 15 shares

[E] Posted 03/10/23
As at 13/10/23:
44 likes etc, 5 comments, 10 shares

[F] Posted 08/10/23
As at 13/10/23:
116 likes etc, 17 comments, 14 shares

[G] Posted 10/10/23
As at 13/10/23:
216 likes etc, 13 comments, 30 shares

[H] Posted 12/10/23
As at 13/10/23:
577 likes etc, 20 comments, 290 shares

Figure 3. Examples of posts from the campaign.

Of note is [H] which, when the data was recorded one day after it had been posted, had accumulated the most likes (577) of any of the posts over the whole month. The number of shares (290) in that short time was also phenomenally large. This could be explained by the heightened focus the day prior to the Referendum. Even so, it is worth taking a moment to compare [D] from early October with [H] from mid-October. The prompt was identical. It included the phrase "long grass," which is an ambiguous term, duplicitously referring to a traditional cultural choice of some Aboriginal people and a derogatory term for the camps of 'homeless' urban fringe-dwellers (Pollard et al., 2017).

Significantly, [D] was the only image out of the whole collection of thirty posts that attracted an objection to the use of AI in the comments. It wasn't clear that it was an objection to AI usage *per se*. One interpretation of the objection was that it stemmed from the saccharine sweetness of the characters' expressions: how could fringe-dwelling 'long grassers' look so happy about their lot?

Another noteworthy statistic concerns the comparably high number of comments regarding image [C]. The image implies that the Aussie Rules term for when someone catches a kicked ball-a 'mark'-may have originated from an Aboriginal word, *mumarki*, for a similar traditional ball-game achievement. Posted during the Aussie Rules AFL Grand Final season, this proved to be a controversial topic.

5 CASE STUDY 3: CREATING FINANCIAL STATEMENTS USING GENAI

This case study explores the integration of GenAI, specifically ChatGPT 3.5, into a first-year accounting unit to enhance learning of fundamental concepts like financial statements, profit and loss accounts, and balance sheets. Students used GenAI to critically evaluate AI-generated outputs, assessing their accuracy and relevance. The goal was to introduce GenAI thoughtfully and meaningfully while promoting deeper learning through interactive engagement (Breen, 2024; Hasan, 2021).

Aligned with the TPACK framework, the study incorporates TK by using GenAI as a tool to assist students in generating and reviewing financial data, such as balance sheets and adjustment entries. Through PK, the approach emphasized critical thinking, with students tasked to identify AI limitations, biases, and inaccuracies in outputs rather than relying on AI responses. Finally, CK remained the focus, as GenAI was used to illustrate key accounting principles and generate real-world examples, enabling students to understand complex accounting concepts in a dynamic way. This integration fostered a deeper understanding of accounting and responsible AI usage, encouraging students to critically reflect on AI's role in modern accounting practices.

5.1 Accounting practices and exercises using GenAI

The intent behind integrating the use of GenAI to teach first-year accounting students was to help them grasp the limitations and risks associated with GenAI. By leveraging GenAI, students were able to engage with interactive and dynamic learning resources that provided immediate feedback and explanations on their practical exercises as they assessed the AI generated content for accuracy and relevance. Students were encouraged to use GenAI to learn challenging concepts like adjustment entries. They were asked to use an approach where GenAI was required to assess students' understanding by asking questions about adjustment entries and giving them clues and hints if they were wrong, but not to provide the correct answers. The students observed that most of the adjustment entries given by GenAI were accurate. In some concepts, the students pointed out that GenAI did not use the Australian context in its outputs, and this was the bias identified. For example, it was preparing a 'Statement of Retained Earnings' instead of a 'Statement of Changes in Equity.' The students shared with the class when they received correct answers to their prompts.

By critically evaluating the feedback produced by GenAI, the students had the opportunity to enhance their comprehension and critical thinking skills, as suggested by existing research (Burney et al., 2023). For example, they could figure out that, in most instances, GenAI output did not provide accurate totals, and when pointed out, it fixed the totals and apologised for the oversight. Ballantine et al. (2024) also cautioned that GenAI generates inaccurate answers for technical questions in accounting. Attention to detail is considered pertinent for the accounting profession and illustrating the instances where GenAI generated incorrect (but equal) totals provided valuable learning experiences for the students. With inaccurate answers, technically called 'hallucinations' (Burney et al., 2023), students learned how to frame prompts, how to deal with GenAI hallucinations, and the necessity of cross verifying the GenAI generated outputs. They also realised the significance of human judgement before reporting financial statements. Students gained an understanding of the risks associated with irresponsible or reckless use of GenAI in completing their assignments.

This case study contributes to the limited literature on the impact of GenAI in accounting education in the Australian context and responds to the call for research to guide and integrate GenAI into accounting teaching and learning practices (Ballantine et al., 2024; Burney et al., 2023; Kommunuri, 2022), by emphasising the need to focus on the human element in accounting education, with particular attention to considering the unique characteristics of the student cohort before implementing wide scale GenAI integration. Further, this case enriches GenAI literacy literature in general, with a specific focus on accounting education. Insights from our experiment with GenAI in an accounting classroom extend the idea presented by Burney et al. (2023) that educators are responsible for preparing accounting students to use GenAI responsibly and ethically.

Through this approach, students developed a deeper understanding of the foundational knowledge and basic functionalities of GenAI, as well as the associated risks and challenges in preparing financial statements.

6 CASE STUDY 4: PROJECT-BASED LEARNING (PBL) REIMAGINED

This case study explores how students used Gen-AI in the "Business in the Digital Age" unit, emphasizing the iterative process of prompt generation and refinement. The unit, designed to develop essential digital skills, employed a co-design methodology with students and their employers to enhance workplace competencies. Authentic learning opportunities were provided, allowing students to critically analyze and utilize AI tools like ChatGPT and Gemini to solve workplace issues. One assessment required students to address data integrity concerns and devise strategies to prevent future complications, integrating their research with GenAI outputs. This approach aligned with the TPACK framework by incorporating TK through AI prompt engineering, PK by promoting critical analysis of AI outputs, and CK by addressing real-world business challenges such as data safety and ethical practices. The assessment fostered both practical AI skills and strategic thinking for workplace applications.

6.1 PBL practices using GenAI

This case study was structured in three distinct phases to explore students' engagement with GenAI and their approach to addressing data integrity issues:

- Initial prompt generation and analysis: In the first phase, students were tasked with generating prompts and capturing the corresponding responses from GenAI. They then critically analysed these responses, assessing their accuracy, relevance, and effectiveness. Based on this analysis, students iterated on their prompts to refine and improve the AI's outputs.

- Integration and review: The second phase involved integrating the refined prompts and responses into practical scenarios. Students recorded and reviewed how these iterations supported their recommendations for a business context. This phase evaluated the usefulness of the improved prompts in providing actionable insights and supporting decision-making.

- Development of data integrity strategy: In the final phase, students were required to formulate a written strategy addressing data integrity concerns. This strategy included recommendations for ensuring the accuracy, security, and ethical use of data generated through GenAI, reflecting their understanding of the implications for business practices and data management.

The outcome allowed students to implement strategies for using GenAI as a tool in the workplace. One key learning from debriefing with students was moving from 'Google'-type questions to more context-based questions to maximise GenAI's potential in the workplace. Students learned the importance of iterative refinement in prompt engineering to achieve more accurate and relevant AI-generated responses. This process highlighted how small changes in prompts can significantly impact the quality of AI outputs. However, some students struggled to identify which prompt modifications led to significant improvements in the responses generated by AI, resulting in a potentially inefficient refinement process. Excessive refinement also risks overfitting, where prompts become too tailored to specific contexts, limiting their generalisability and applicability to other scenarios.

The case study underscored the value of critical analysis in evaluating AI-generated responses, and students developed skills in assessing the effectiveness of AI outputs and identifying areas for improvement. However, it was also identified that students may introduce their own biases when analysing AI responses, which could affect the objectivity of the evaluation. They might also find it challenging to fully grasp the limitations of AI, leading to unrealistic expectations or ineffective prompt modifications.

By integrating refined prompts into business scenarios, students gained insight into how AI-generated information can be practically applied to support decision-making and business recommendations. However, the challenge is that AI-generated responses may not always align with real-world business needs, making it difficult for students to effectively integrate these outputs into practical recommendations due to contextual misalignment.

The exercise in developing a data integrity strategy illuminated key concerns related to the accuracy, security, and ethical handling of data generated by GenAI. Students found it overwhelming to address these concerns, particularly in translating theoretical strategies into actionable practices, especially in real-world settings where data management systems and practices vary and were not generated by the GenAI prompts. Students learned about the potential risks and best practices for managing data integrity. They engaged in reflective practice, enhancing their ability to evaluate and improve their work. This process fostered a deeper understanding of both the strengths and limitations of GenAI and their approach to addressing data integrity issues. The development of a written strategy for addressing data integrity issues equipped students with the skills to formulate actionable recommendations and strategies in a real-world context, demonstrating how theoretical concepts of GenAI and data management can be applied to practical scenarios, bridging the gap between academic learning and real-world application.

Introducing a new technology requires careful management of comfort zones. The iterative process and strategy development may present complex problem-solving challenges that are difficult for students to navigate effectively. Time must be given to understand what the technology does and how it can be used ethically and safely. Workshops were delivered to support student learning and increase their digital confidence in the workplace. A scaffolded approach is crucial to supporting learning, considering their knowledge, skill base, and experiences. PBL enables the content and assessment construction to be student-centred. A guided inquiry approach supports students who may be less inclined to use any form of GenAI in their workplace. This guided inquiry provides the foundation for students to further research and explore various options. Creating a safe environment for experimentation is essential. Understanding the importance of integrity issues, such as data integrity, and the ethical and operational parameters that businesses need to employ when using any form of AI was a focus, thus promoting discussions and professional reflections on the potential use of AI in daily tasks.

Aligning assessments with current workplace practices is crucial. Collaborating with different industries to understand and acknowledge the tasks completed by different teams in a workplace ensured the relevance of the assessment piece. PBL enabled a co-design for this GenAI assessment by incorporating challenges in various industries to address ongoing concerns around data safety (Duggineni, 2023; Lebdaoui et al., 2016).

Detailed feedback from students and industry partners highlighted significant improvements in skills and workplace practices. Students reported increased confidence in using GenAI tools and a greater understanding of data integrity issues, while industry partners noted enhanced problem-solving and critical thinking abilities among their employees. Integrating GenAI and PBL fosters critical thinking, problem-solving, and adaptability, ensuring that graduates are proficient in their technical skills and capable of innovative and strategic thinking.

Moving forward, continuous collaboration with industry partners and ongoing program evaluation will be essential to maintaining its relevance and effectiveness. This approach enhances student learning outcomes and contributes to creating a well-equipped workforce to navigate and thrive in an increasingly digital and dynamic world. Adaptability and continuous learning will be critical, and potential future developments could include expanding the program to incorporate more advanced GenAI tools and further diversifying the range of industry partners involved.

7 CASE STUDY 5: DEVELOPING FUNDAMENTAL RESEARCH SKILLS IN UNDERGRADUATE PSYCHOLOGY USING GENAI

This case study explores the essential competencies required for psychology graduates, including research skills, critical thinking, communication, and a strong understanding of human behaviour and professional ethics. These competencies, known as ‘psychological literacy’ (Hulme, 2014), are necessary to meet the standards of professional accrediting bodies like the Australian Psychology Accreditation Council (APAC, 2019). The undergraduate psychology curriculum typically follows the scientist-practitioner model (Jones & Mehr, 2007), emphasising the integration of research evidence with clinical expertise, considering patient characteristics and preferences (American Psychological Association [APA], 2006).

The “Personal and Professional Development” unit for first-year psychology students is designed to build foundational academic and professional skills, including study strategies, communication, and APA referencing. By integrating GenAI, the unit enhances students’ digital literacy and research skills. GenAI tools help students efficiently find, summarise, and reference scientific literature. Key assessments, like an annotated bibliography on GenAI’s impact on psychology and an e-portfolio, encourage students to develop competencies while ethically engaging with AI.

Aligned with the TPACK framework, this unit integrates TK (GenAI tools), PK (active learning and critical thinking), and CK (psychological literacy and research skills) to prepare students for future roles in psychology or related fields.

7.1 Practices and exercises using GenAI

GenAI was integrated into each weekly topics, providing students with hands-on experience and promoting a nuanced understanding of the ethical considerations surrounding the use of GenAI technologies. An inherent requirement of the unit is to teach students how to engage with GenAI as a form of digital literacy, in line with contemporary educational frameworks (Tinmaz et al., 2022). This includes, for example, understanding how the GenAI tool works (including its limitations), strategies for using GenAI tools effectively (including checking content for accuracy and not using it to replace their critical thinking and evaluation), and discussions around plagiarism (referencing ideas that are not their own). The main message around GenAI use is that it can function as a very effective research assistant, and that using these tools is not considered cheating unless it is asked to cheat.

The unit covers various GenAI tools designed to assist with general studying, such as flashcard development, explanation of difficult concepts, quiz creation, organising schedules and documents, and transcribing audio recordings (e.g. lectures, TED Talks, and YouTube videos). Some of the tools mentioned include ChatGPT, Tutor AI, Gizmo, Explain It Like I’m Five, Turbolearn, Google Keep, Evernote, Skeleton Fingers, and Notion. The unit introduces tools designed to facilitate searching scientific literature using AI, which can be used alongside traditional academic library databases and Google Scholar. These new tools use GenAI to find links between articles and topics from large databases and move away from traditional library search systems that relied on keyword searches. Academic literature can be located using search terms (e.g. Semantic Scholar), visual maps of connected papers (e.g. Litmaps, ResearchRabbit, Connected Papers), or by asking direct and specific research questions (e.g. Elicit, Consensus). TLDR (Too Long; Didn’t Read) GenAI-generated summaries of articles make navigating results easier. The unit also covers tools that aid in reading and summarising literature, making it easier to navigate scientific articles (Semantic Reader, Google Scholar Reader), providing article summaries (Scholarcy, Elicit), and asking direct questions about the articles (ChatPDF, Ask Your PDF, and Unriddle, as well as LLM such as ChatGPT and Microsoft Co-Pilot).

7.2 Annotated Bibliography Assessment

The annotated bibliography (AB) assignment provided students with the opportunity to display their research skills. In this task, students were required to create a research question related to the impact and applications of GenAI in the field of psychology. Students needed to locate relevant peer-reviewed journal articles, critically evaluate them, and apply the APA referencing style. The assignment aimed to explore how advancements in GenAI were influencing research, therapy, and our understanding of human behaviour within the discipline of psychology. Students were encouraged to tie their research question to their career goals. For instance, if a student aspired to work as a clinical psychologist, they were encouraged to explore a research question relevant to that area of clinical endorsement. An example could be exploring the use of GenAI in diagnosing mental health disorders in clinical practice.

Students then used both traditional and GenAI tools to find relevant articles, summarise the findings, consolidate the findings from all articles, and prepare the annotations in APA format. They then reflected on their experience, considering factors such as the tools used, how they were used, the experience of using the tools, and the accuracy, reliability, and effectiveness of the tools. The final reflective questions asked them to discuss the advantages and challenges of GenAI in academic and clinical contexts.

7.3 e-Portfolio Assessment

Online portfolios serve as a modern equivalent of traditional paper-based resumes. They are highly effective for job hunting, as they allow individuals not only to describe their skills and experience but also to demonstrate them (Kilroy, 2017; Ciesielkiewicz et al., 2020). For instance, individuals can include a presentation to highlight their oral communication skills. Additionally, portfolios are valuable for encouraging students to reflect on the skills and knowledge they have gained from their degree (Ring et al., 2017). The demand for ‘job-ready’ graduates has become a necessity in Australia overall (Gill, 2018) and has also been a specific topic of discussion within the psychology discipline (Schweinsberg et al., 2021).

For this assessment, students were tasked with creating a professional online career portfolio using the Portfolium platform. This portfolio helped them in identifying and marketing the transferable knowledge and skills they have acquired throughout their degree. It included a brief biography/introduction, descriptions, and examples of competencies, as well as a skills statement. To complete these tasks, students were encouraged to use GenAI tools, particularly LLMs such as Microsoft Copilot, to help identify and articulate their skills and experiences. For instance, they could summarise their key skills and experiences by uploading their CV/resume. Students could also employ these tools to craft a unique and compelling byline (or catchphrase) and image that best represents themselves for their profile. Associated with this, during class, students developed a personal elevator pitch using the assistance of GenAI tools.

Some students felt uncomfortable or struggled with confidently using the tools without breaching academic integrity. Unfortunately, to date, universities have been slow in keeping up with the pace of GenAI in teaching and in supporting both students and teaching staff in its use, and detection of AI use remains problematic (Lee et al., 2024). There is also a risk of students relying too heavily on GenAI tools, potentially neglecting the development of fundamental skills (for example, understanding and critiquing scientific literature, developing research questions, and key writing skills such as logical structure). That is, students must be able to understand the task to determine if GenAI outputs are accurate, which resonates with the other case studies discussed in this paper.

It is essential to ensure that GenAI is used as a complementary tool and not a replacement for traditional skills to develop well-rounded and competent future psychologists. While integrating GenAI into the curriculum has shown that these tools can be valuable for researching and studying tasks, it is critical to carefully consider their ethical use and ensure the preservation of fundamental skills for graduates. All of this can only be achieved if academic staff are provided with training and support for the use of GenAI (Zhang & Zhang, 2024).

8 DISCUSSION

In the context of the provided case studies, the overlapping areas in TPACK offer insights into how GenAI can be integrated effectively into teaching and learning. TPK refers to how technology can influence teaching methods and the process of learning. In the case studies, GenAI is used to enhance pedagogical strategies and engage students in active, iterative learning. In the graphic design assessment, GenAI tools resist LLM automation, prompting students to engage more deeply with creative tasks. The technology encourages students to reflect on and critique AI's role in their field, fostering an interactive learning experience that promotes critical thinking about both AI's strengths and limitations in creative contexts. In PBL with GenAI, students iteratively refined AI prompts, engaging in a feedback loop to improve responses. This iterative, context-based questioning enhances pedagogical approaches, encouraging deeper thinking and refinement of queries to develop skills relevant to real-world professional scenarios.

TCK concerns how technology alters the way content is taught or understood. It highlights how GenAI can reshape the presentation, understanding, or exploration of content. Creating financial statements with GenAI allowed students to assess the accuracy of AI-generated content, which often contained mistakes. This hands-on experience gave students a better understanding of both financial concepts and the limitations of AI-generated outputs, linking technological tools directly to content mastery. In image generation for a social media campaign, TCK is demonstrated as students explore the ethical implications of using AI-generated images in culturally sensitive contexts. The use of AI to generate visual content reshapes how students approach visual design, ensuring that technology enhances content without misrepresenting cultural knowledge.

PCK relates to how educators adapt their teaching strategies to make the subject matter more accessible and understandable. It's about blending pedagogical approaches with deep content knowledge. In the psychology competencies and GenAI case, PCK is reflected in teaching students to integrate GenAI into their development of core psychology skills, research, communication, and ethics. Educators teach psychological content while ensuring students use AI responsibly, focusing on how AI can enhance understanding and application of human behaviour and ethics in professional practice. For graphic design, the educator uses the resistance of GenAI to automate creative processes to emphasise traditional design skills, blending pedagogical strategies with CK of graphic design while using technology to expand students' learning experiences.

9 CONCLUSION AND RECOMMENDATIONS

As academics are much concerned about GenAI and how this is shaping the world, the 'genie is out of the bottle', and GenAI will continue to influence various sectors and employability skills of students. Higher education institutions are foundational grounds where students learn and get ready to be employed in an industry. Learning GenAI skills, using it responsibly and understanding its importance are very crucial for future graduates as more industries and professions will be integrating it in future and classrooms are the place where it can be experimented with and taught how to use it responsibly and ethically. Thus, a culture needs to be built around the ethical and responsive use of GenAI to understand the biases it can generate. It is important to ensure that the output generated by GenAI tool must be critically analyzed for any misrepresented result, symbols, patterns, or styles. Students should be taught prompt engineering to refine and contextualize outputs generated by GenAI. Students should be aware of the significance of the elements they use in their discipline as GenAI is not capable to handle the biases the human brain knows about. Instead of taking all generated output from GenAI as positive, students' must also look at the accuracy of the results and their representation they depict, avoiding (mis)appropriation. From this study we can draw the following five recommendations:

- Higher education institutions should incorporate GenAI literacy into both student and staff training programs.

- Institutions must continuously review and adapt their assessment methods to keep pace with the evolving capabilities of GenAI technologies.

- A culture of ethical and responsible use of GenAI should be fostered. This includes understanding and mitigating biases that GenAI tools may introduce.

- Students should be taught prompt engineering to refine and contextualize the outputs generated by GenAI.

- Encourage students to critically analyse the outputs generated by GenAI tools, ensuring they do not take the results at face value but instead verify their accuracy and relevance.

Future research should focus on several key areas to deepen our understanding of GenAI in education. First, it is essential to validate the effectiveness of GenAI practices across various academic disciplines to better understand the unique challenges and benefits of integration in different educational contexts. Second, further investigation is needed into the ethical challenges associated with GenAI, including its potential impact on traditional teaching roles and the risk of exacerbating educational inequalities. Third, research should explore students' attitudes toward GenAI and examine how its use influences their learning outcomes, personal development, and career prospects. Fourth, longitudinal studies are necessary to assess the long-term impact of GenAI on teaching methodologies, student engagement, and overall educational outcomes. Finally, there is a pressing need to develop comprehensive policies and ethical frameworks to guide the responsible and equitable deployment of GenAI in higher education settings.

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