Interactive Learning Environments

ISSN: 1049-4820 (Print) 1744-5191 (Online) Journal homepage: www.tandfonline.com/journals/nile20

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To cite this article: Hibah Khalid Aladsani (2025) Developing postgraduate students' competencies in generative artificial intelligence for ethical integration into academic practices: a participatory action research, Interactive Learning Environments, 33:10, 5747-5765, DOI: 10.1080/10494820.2025.2487517

To link to this article: https://doi.org/10.1080/10494820.2025.2487517

INTERACTIVE LEARNING ENVIRONMENTS
2025, VOL. 33, NO. 10, 5747–5765
https://doi.org/10.1080/10494820.2025.2487517

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Developing postgraduate students' competencies in generative artificial intelligence for ethical integration into academic practices: a participatory action research

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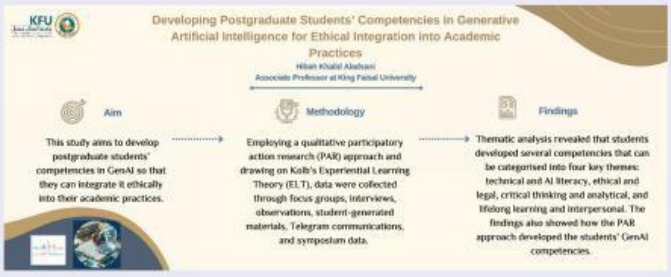
ABSTRACT

Generative artificial intelligence (GenAI) has been integrated into everyday life, including education. Educational institutions cannot prevent their members from using this technology; however, they can develop awareness and competencies to apply GenAI ethically. This study aims to develop postgraduate students' competencies in GenAI so that they can integrate it ethically into their academic practices. Employing a qualitative participatory action research (PAR) approach and drawing on Kolb's Experiential Learning Theory (ELT), data were collected through focus groups, interviews, observations, student-generated materials, Telegram communications, and symposium data. Thematic analysis revealed that students developed several competencies that can be categorised into four key themes: technical and AI literacy, ethical and legal, critical thinking and analytical, and lifelong learning and interpersonal. The findings also showed how the PAR approach developed the students' GenAI competencies. The discussion emphasises the importance of developing these competencies. Finally, implications and recommendations are provided to inform future higher education practices and research.



ARTICLE HISTORY
Received 28 September 2024
Accepted 27 March 2025

KEYWORDS
GenAI; AI; ChatGPT; participatory action research approach; algorithms; higher education

Introduction

Artificial intelligence (AI) has significantly impacted many fields by allowing machines to mimic human capabilities, such as learning, reasoning, and problem-solving. Generative artificial intelligence (GenAI) takes this a step further by creating entirely new content, such as text, images, and videos, based on user instruction "prompts" (Lim et al., 2023). Unlike traditional AI, which analyses and categorises existing data and often uses predetermined responses, GenAI utilises deep learning models trained on vast

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datasets. This allows GenAI to generate novel and creative content that can even resemble human creations (Mannuru et al., 2023). The rapid spread of GenAI affects every aspect of human life, including education. GenAI's ability to create new materials brings hopes and threats that may reshape the contemporary educational environment and higher education (Lim et al., 2023; Tlili et al., 2023). In fact, students' use of GenAI has already caused an uproar in academia. Some institutions prohibit the use of GenAI, some allow it without limits, and some permit its use with conditions and rules (Lim et al., 2023). Thus, to ensure that students understand GenAI and how to use it ethically in their academic practices, it is crucial to develop their competencies in this technology (Annapureddy et al., 2025; Chiu et al., 2024). Postgraduate students represent a unique group within higher education due to their assignments and tasks, which demand greater academic accuracy and integrity compared to those of undergraduate students. Postgraduate education's emphasis on ethical and legal academic practices makes it an ideal context for exploring the integration of GenAI in alignment with these standards. Adopting a qualitative participatory action research (PAR) approach, and drawing on Kolb's Experiential Learning Theory (ELT), this study specifically targets postgraduate students and aims to develop their competencies in GenAI so that they may ethically integrate it into their academic practices.

Literature review

Introducing GenAI

The field of GenAI has witnessed a surge in development, and various emergent models have captured the public interest. Since its launch in November 2022 by OpenAI, ChatGPT has achieved global recognition for its human-like conversational capabilities and insightful responses (Chan & Hu, 2023). Another noteworthy GenAI model is Gemini (formerly Bard), which excels in massive multitask language understanding. This allows it to leverage its reasoning capabilities for deeper analysis before tackling complex questions (Pichai & Hassabis, 2023). Additionally, Microsoft recently introduced Copilot (formerly Bing AI), which merges the power of large language models with access to Microsoft's 365 applications and vast search index (The Microsoft Bing Team, 2023). Every GenAI model possesses distinct capabilities designed to address specific user needs, from casual conversation to specialised support tasks.

Using GenAI in higher education

GenAI offers several advantages within the educational landscape. In higher education, its adaptability allows it to tailor the learning experience for each student, catering to their unique needs and learning styles (Silva et al., 2024). This personalised, confidential environment can reduce learning anxiety, provide on-demand answers and solutions, and promote self-regulated learning through motivation and the reinforcement of positive learning habits (Al Lily et al., 2023). In language learning, students can benefit from GenAI's definition of new words, translations to and from various languages, correction of grammatical errors, and assistance with reading and writing skills (Kohnke et al., 2023). This also empowers students, especially non-native speakers, to improve their research capabilities and to benefit from accessible learning opportunities available in other languages (Mannuru et al., 2023). In academic writing, a notoriously time-consuming and challenging task, GenAI can act as an impressive assistant that analyses the learner's writing and personalises outputs based on the learner's needs (Chan & Hu, 2023). GenAI can engage in brainstorming sessions, fulfil information requests, provide access to vast resources, and assist with, among other tasks, reference searching, summarising, data collection, and information synthesis (Atlas, 2023). GenAI can also be used to foster creative thinking, enabling students to approach assignments in original and comprehensive ways, reduce overall effort, and align students' work with learning objectives (Urban et al., 2024).

On the other hand, there are concerns regarding potential misuse and issues related to ethics, plagiarism, and academic integrity. GenAI's ability to generate text raises the potential for plagiarism and the possibility of students or researchers incorporating outputs without proper attribution (Tlili et al., 2023). Sole reliance on GenAI for academic papers can compromise the authenticity and originality of the work (Silva et al., 2024). The ability to generate realistic text presents the risk of deepfakes and fabricated information, as GenAI provides text output that appears to be coherent and logically relevant to the topic, but the text can be based on imaginary references, which potentially compromises the trustworthiness of the technology as a research and educational resource (Holmes & Miao, 2023; Tlili et al., 2023). Overdependence on GenAI-generated content could hinder the development of critical thinking and independent research skills, potentially fostering a tendency towards intellectual laziness (Silva et al., 2024; Tlili et al., 2023). Excessive reliance on GenAI may also risk homogenising writing styles and stifling individual expression, thereby weakening students' writing abilities (Mannuru et al., 2023). Data privacy and security are also paramount concerns – the sensitive nature of academic data necessitates robust safeguards against breaches and unauthorised access (Luo et al., 2024; Mannuru et al., 2023; Tlili et al., 2023). Worryingly, the storage of user interactions by some GenAI models raises questions regarding intellectual property rights and potential plagiarism issues, particularly regarding the use of unattributed data for training (Holmes & Miao, 2023; Luo et al., 2024; Tlili et al., 2023). Digital poverty, potentially exacerbated by language barriers and affordability limitations, can create disparities in access to GenAI's benefits (Holmes & Miao, 2023; Mannuru et al., 2023) Finally, the control exercised by GenAI developers raises concerns about the potential for bias in information access and the marginalisation of certain voices (Holmes & Miao, 2023). Training data biases can be unintentionally perpetuated in GenAI's outputs, impacting accuracy and objectivity (Giannini, 2024; Mannuru et al., 2023).

GenAI competencies in education

Enhancing learners' competencies in GenAI is a vital global strategic initiative for educating the next generation, as evidenced by The United Nations Educational, Scientific and Cultural Organization's (UNESCO's) AI education report (Giannini, 2024). GenAI competency refers to the ability of users to understand the definition of GenAI, use it ethically, effectively communicate with it in diverse settings, and apply it in beneficial ways (Chiu et al., 2024). The integration of GenAI in education requires a structured approach to ensure that students develop competencies aligned with the demands of the AI era. UNESCO's AI competency framework for students consists of twelve competencies and emphasises four key dimensions: human-centred mindset, ethics of AI, AI techniques and applications, and AI system design (Miao & Cukurova, 2024). Each dimension consists of three competencies. The human-centred mindset dimension includes human agency, human accountability, and citizenship in the era of AI. The ethics of AI dimension includes embodied ethics, safe and responsible use, and ethics by design. The AI techniques and applications dimension includes AI foundations, application skills, and creating AI tools. The AI system design dimension includes problem scoping, architecture design, and iteration and feedback loops.

While the UNESCO framework focuses on the general integration of AI in education, some frameworks specifically address the competencies required for GenAI. For example, Chiu et al. (2024) suggested five key components of the GenAI competencies framework: technology, impact, ethics, collaboration, and self-reflection. Annapureddy et al. (2025) suggested a framework that proposed twelve defining competencies: basic AI literacy, knowledge of generative AI models, knowledge of the capacity and limitations of generative AI tools, skill to use generative AI tools, ability to detect AI-generated content, ability to assess the output of generative AI tools, skill in prompting generative AI tools, ability to programme and fine-tune, knowledge of the contexts where generative AI is used, knowledge of the ethical implications, knowledge of legal aspects, and the ability to continuously learn.

This study narrows its focus to competencies specific to postgraduate students, particularly in the context of GenAI. It adopts principles from the frameworks of UNESCO, Chiu et al., and Annapureddy et al. due to their comprehensive approaches to fostering essential GenAI competencies, especially in ethics and human-centred engagement. These principles align with the study's objective of developing postgraduate students' competencies to ethically integrate GenAI into academic practices, ensuring they become informed and responsible users of this technology.

These frameworks emphasise the importance of AI literacy and students' abilities to understand GenAI concepts and what GenAI can and cannot do, to compare GenAI to other existing AI tools, and to use it effectively (Annapureddy et al., 2025; Chiu et al., 2024). The limited digital literacy within the academic community further emphasises the need for training to ensure responsible GenAI integration into academic practices (Lim et al., 2023). AI literacy forms the foundational competency upon which other skills build. While currently essential, technical skills may become less critical over time; instead, the cognitive and socio-emotional ability to craft effective prompts and engage meaningfully with GenAI could become more important (Giannini, 2024). Students should know how these systems operate and be aware of ethical and practical considerations related to their use, as well as be able to critically evaluate GenAI output. Students should consider the social and professional contexts in addition to the ethical and legal contexts (Annapureddy et al., 2025).

Purpose of the study

Multiple studies have investigated the use of GenAI in higher education, its benefits and challenges, and students' perceptions of its use in their learning (Atlas, 2023; Holmes & Miao, 2023; Mannuru et al., 2023; Silva et al., 2024; Tlili et al., 2023); however, few studies have considered the competencies students, especially graduate students should acquire and develop in their use of GenAI. There is also a dearth of studies examining the practical applications of the development of these competencies. Therefore, this study aims to develop postgraduate students' competencies in GenAI to enable its ethical integration into academic practices. Using the PAR approach, the study investigates the following question: What competencies did postgraduate students develop in GenAI, and what strategies were implemented to facilitate the ethical integration of these competencies into academic practices?

Methodology

As this study employs action research in its methodological nature, it is grounded in two complementary frameworks: Kemmis' PAR and Kolb's ELT. Both frameworks stem from the work of Kurt Lewin, who is often referred to as the originator of Action Research (Kemmis & McTaggart, 1982; Kolb, 1984). Together, these frameworks provide a robust foundation for understanding how postgraduate students can develop competencies in GenAI while addressing the ethical challenges associated with its academic integration.

This study adopted the qualitative PAR approach to empower students to assume co-facilitator roles, fostering dual engagement as learners and facilitators within the research process (Kemmis et al., 2014; MacDonald, 2012). PAR is characterised by its suitability for research related to teaching and learning. It is a systematic investigation process carried out by educators in their teaching environment to collect specific information that helps improve teaching methods, enhance students' educational levels, and develop their competencies and skills. This is achieved by enabling the educator and students to choose appropriate educational strategies that meet their needs, rather than imposing general or external methods and strategies that may not suit their needs and interests (Stringer, 2013). I chose the qualitative rather than the quantitative research approach because I aimed to develop the competencies of GenAI among female postgraduate students in ways and practices that suit their levels, abilities, and desires, rather than imposing pre-prepared methods on them. Additionally, this approach allowed me, as a researcher, to communicate directly with students through observations and interviews and to understand their needs and opinions

about the strategies and activities applied, as well as their benefits in achieving the research objectives (Stringer, 2013).

Kemmis' PAR emphasises the cyclical nature of learning and collaborative inquiry, where participants work with researchers to identify problems, plan interventions, and reflect on outcomes. The iterative cycles of planning, acting, observing, and reflecting enable a seamless integration of personal learning and group-based transformation. Kemmis' approach further highlights the importance of critical reflection, not only on the outcomes of action but also on the broader social, cultural, and ethical dimensions of the research (Kemmis et al., 2014).

Kolb's ELT emphasises learning through experience (Kolb, 1984). This theory portrays learning as a spiral of four intertwined stages: concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE) (Kolb & Kolb, 2009). In addition, Kolb's ELT identifies four distinct learning styles based on how individuals prefer to engage with the learning process: Diverging, Assimilating, Converging, and Accommodating. These styles emerge from the interplay between two key dimensions: how individuals grasp experiences (Concrete Experience or Abstract Conceptualisation) and how they transform them (Reflective Observation or Active Experimentation) (Kolb & Kolb, 2009).

The cyclical nature of PAR, which involves extensive observation, reflection, and decision-making based on the outcomes of this reflection, aligns seamlessly with Kolb's ELT, which emphasises the importance of reflective observation and active experimentation as key components of effective learning. This combined theoretical foundation supports the objectives of this research, as it encourages students to engage with real-world tasks, reflect on their experiences, and develop theoretical insights that inform their future practices.

Context

The study was conducted within the context of one course titled Development of Electronic Educational Resources, delivered by me (the researcher) in the master's programme of educational technology at King Faisal University in Saudi Arabia. The study was conducted during (September to December 2023). This course was chosen for the study because its completion requires various academic tasks, including creating multimedia content (images-audio-video-infographic), evaluating educational platforms, and writing short research papers.

Participants

The participants were five female postgraduate students enrolled in the course. The students came from various undergraduate backgrounds and possessed various digital skills. Their ages varied between 24 and 30 years old. This study was approved by the Institutional Ethics Committee of King Faisal University for studies involving humans (KFU-REC-2024-APR-ETHICS2227). Participation was entirely voluntary. Before the study process began, I obtained informed consent from the participants. Throughout the study, participants were given the right to decline to answer any question and to withdraw from the project at any time. It was communicated to them that their names were not required. Additionally, they were informed that all data would be analysed by me and destroyed after the publication of the study.

Research design and procedure

This study adopted the spiral of action PAR research model proposed by Kemmis et al. (2014). This cyclical framework emphasises ongoing improvement through four interconnected phases: planning, acting, observing, and reflecting. This PAR project spanned 14 weeks (September–December). The study was conducted in two cycles: the first cycle lasted for 8 weeks, covering September and October, while the second cycle lasted for 6 weeks, covering November and December.

First cycle

At the *planning stage*, I gathered baseline data through student discussions to inform the development of goals and an actionable plan, leading to the identification of two major shortcomings: a general lack of GenAI literacy competencies and confusion regarding how to use GenAI ethically. I collaborated with my students to co-construct an action plan that outlined the necessary activities, timelines, and responsibilities. This collaborative plan aligns with the accommodating learning style of learners who prefer to work with others, set shared goals, and strive to achieve them (Kolb & Kolb, 2009). The plan focused on understanding the definition, concepts, and unique capabilities of GenAI, the ability to use GenAI models and tools, content creation, and prompt engineering. Additional aspects that required further development were ensuring responsible and secure use of GenAI while adhering to moral standards and regulatory requirements and understanding ethical guidelines and legal frameworks. The suggested action plan involved the students searching in traditional search engines and social media sites, utilising GenAI tools, and participating in class discussions about what they were learning. In addition, I established a Telegram group as a communication platform and resource repository to support student-led exploration. These activities align with the diverging learning style of learners who enjoy working in groups, gathering information, and engaging in brainstorming sessions, as well as the converging style of students who prefer experimenting with new ideas and practical applications (Kolb & Kolb, 2009).

During the *acting stage*, students completed various tasks to develop their GenAI fundamental knowledge and digital skills, such as asking ChatGPT to introduce itself. Students utilised various tools, such as ChatGPT, Gemini, Copilot, and Bing Image Creator, and they presented their tasks in a multimedia format (text, images, and videos) created by GenAI.

At the observing stage, I collected comprehensive data to assess the effectiveness of the action plan.

All participants (including the researcher) participated in the *reflecting stage*. It was crucial to allow each student to discuss their achievements, their contributions, and what they had learned, as well as what they still needed to learn and what they would do in the next step. The reflecting stage described by Kemmis et al. (2014) aligns seamlessly with the reflective observation stage by Kolb and Kolb (2009) and suits the assimilation learning style of learners who prefer reading, thinking, and taking time to reflect. I analysed the collected data by applying reflexive thematic analysis (MacDonald, 2012), which allowed me to assess the outcomes against the initial objectives and goals set during the planning phase and to reflect on the effectiveness of the actions and their impact on the students' improvements. I used these reflective insights to adapt, refine, and redesign the action plan for the subsequent cycle in the second cycle.

Second cycle

The four stages were repeated with modifications made in light of the findings of the first cycle. While the students developed the basic competencies of GenAI in the first cycle, further opportunities for improvement were identified in the second one, including critical thinking and analytical competencies and lifelong learning competencies. The plan for the second cycle focused on developing each student's ability to evaluate information, identify biases, assess reliability, make informed decisions, adapt to technological advancements, work collaboratively with others, and comprehend GenAI's probable impact on students' future work and on society.

In the second cycle, in addition to the activities applied in the first one, the focus shifted to research tasks, such as utilising GenAI to generate a new academic article and rewrite a student paper. This task was followed by a comparative analysis of the original student paper, the rewrite, and the new article. The comparative analysis was conducted by the students as an activity to enhance their critical thinking skills while utilising GenAI. An online symposium, which was entirely created and presented by the students, transferred the students' knowledge, competencies, and skills to the broader community. The activities of this term align with all the learning styles described by Kolb and Kolb (2009).

Data collection methods

The triangulation strategy employed in this study incorporated multiple data sources to ensure a comprehensive understanding of the research problem. Focus group interviews, lasting 30–90 min, were conducted at key stages of the project (twice each cycle) to explore student perspectives. Examples of questions posed in these focus groups included: What type of GenAI have you used? Do you notice any differences between them? Have you noticed differences in how your peers use GenAI compared to your own approach? If yes, what are they? Can you share any specific examples where GenAI either helped or challenged your learning process? These focus group interviews were designed to generate valuable discussions and interactions among participants who shared a common interest (Bryman, 2016). A focus group approach was chosen over individual interviews at this point because it allows for collaborative data generation, enabling participants to comment on and respond to each other's remarks, which enriches the research topic.

On the other hand, individual interviews, lasting 10–30 min, were conducted to collect each student's personal perceptions and experiences. Examples of questions in the individual interviews included: How do you utilise GenAI in your study and research? Do you trust GenAI's responses, and why? Do you think using GenAI has improved your academic skills, how? Are there any skills you feel have been overlooked or underdeveloped due to relying on GenAI? Explain? These individual interviews provided an opportunity to uncover insights that students might not have felt comfortable sharing with their peers in the focus groups.

I collected and analysed classroom observation notes, along with screen recordings of student presentations and assignment discussions. Students also submitted weekly reflection papers detailing what they had learned during the week and what they wished to learn further. These reflections were subsequently discussed in lectures. Content from Telegram was gathered for ongoing analysis of student interactions and resource sharing within the platform. Finally, an online symposium, held at the end of the semester, was recorded for content analysis to gain further insights into the development of students' competencies in utilising GenAI for academic practices.

Data analysis

I employed reflexive thematic analysis (Braun & Clarke, 2022), an inductive approach that acknowledges the researcher's role in interpreting data and emphasises the necessity of conducting deep interpretive analyses rather than a superficial description and summary of the data. I began data analysis concurrently with data collection, ensuring continuous engagement with the dataset.

I followed the six phases of reflexive thematic analysis (Braun & Clarke, 2022). I started by familiarising myself with the data through repeated reading of transcripts from focus groups and individual interviews, observation notes, weekly reflections, and other data sources to identify initial patterns. I then generated initial codes using NVivo 14 software, capturing core meanings from each passage. Examples of the initial codes included "unreliable references", "fabricated information", "fear of plagiarism", and "brainwashing". These codes were organised into broader categories, forming initial themes by identifying shared meanings and relationships. For instance, the initial themes included "Trustworthiness and Credibility", which encompassed the previously mentioned codes, and another theme, "Privacy and Safety". I used NVivo 14 software to facilitate the process of coding and creating themes, which enhanced the research quality. I reviewed and refined the themes iteratively, ensuring they were coherent and distinct while validating them against the original dataset. As a result, the two themes, "Trustworthiness and Credibility" and "Privacy and Safety", became subthemes under the main theme, initially drafted as "Ethical Uses". Each theme was then defined and named to reflect its essence, accompanied by detailed descriptions of its significance and relevance to the research questions. For example, the theme "Ethical Uses" was ultimately named "Ethical and Legal Competencies". Finally, I synthesised insights from

all phases into a coherent narrative, ensuring the organisation and presentation of themes highlighted the depth and richness of the data.

Trustworthiness

I employed various strategies to ensure the quality and trustworthiness of the research procedures and findings, guided by the four criteria of trustworthiness identified by Lincoln and Guba (1985). While there are numerous strategies for ensuring trustworthiness, the following discussion focuses specifically on those used in this study.

To meet the "credibility" criterion, I adopted a triangulation strategy. Multiple data collection methods were employed, including focus groups, individual interviews, observations, weekly reflection papers, analysis of Telegram content, and recordings of the online symposium. To achieve "transferability", I used a thick description strategy. I provided detailed accounts of the study procedures, data collection methods, and analysis, as outlined in the methodology section, enabling readers to assess the applicability of the findings to other contexts. For "dependability", I ensured consistency by leveraging multiple data collection sources, allowing the subject to be examined from various perspectives. Additionally, I maintained an audit trail that documented all the primary data sources. The audit trail provided transparency by detailing how data was collected, analysed, and interpreted to arrive at conclusions. To address "confirmability", I supported the findings with direct quotes from participants' statements, observation notes, and other data sources, ensuring that the results were grounded in the data. I indicated the sources of the findings in brackets. I then interpreted and discussed the findings in light of my experiences, previous studies, and relevant theories, maintaining an objective stance. The use of triangulation and the audit trail further strengthened the confirmability of the research.

Findings

The students developed GenAI competencies that can be categorised into four key themes: technical competencies, which involve understanding and effectively using GenAI tools; ethical and legal competencies that emphasise applying ethical principles and understanding laws to ensure responsible and safe use of GenAI; critical thinking and analytical competencies that focus on evaluating GenAI outputs, applications, and limitations; and lifelong learning and interpersonal competencies that highlight the importance of adapting to advancements, collaborating with others, and reflecting on GenAI's societal impact. The findings additionally showed the most effective strategies for developing postgraduate students' GenAI competencies.

Technical and AI literacy competencies

The students' developments in technical and AI literacy competencies were exemplified by their understanding of GenAI as a new technology, its algorithmic capabilities, and its language capabilities.

GenAI as a new technology

At the beginning of the course, most of the students (excluding two) were unfamiliar with GenAI. The first lecture, therefore, evoked astonishment and admiration. Students frequently expressed their enthusiasm: "This is the first time I heard about GenAI, and I love it". This initial curiosity fuelled their exploration of GenAI, both independently and collaboratively with peers. While the students began with a single model in class, I encouraged them to experiment with other options, leading them to actively seek out and experiment with diverse GenAI models outside of class time. Some developed a preference for the models that best suited their individual needs, as observed when some students preferred Copilot, while others favoured ChatGPT *(Observation)*.

Each lecture provided a platform for students to discuss their discoveries and experiences, showcasing a progressive improvement in their ability to apply GenAI effectively. For example, when students reported frequent instances in which GenAI either failed to respond or provided irrelevant answers due to misunderstandings, they attributed this to their questioning methods and sought me out for solutions, which led to an exploration of prompt engineering techniques. However, while initially helpful in overcoming some limitations, prompt engineering introduced new challenges. Students found success with direct prompting (zero-shot) and prompting with examples. However, complex techniques, such as chain-of-thought prompting or using multiple prompts in a single message, proved confusing. Consequently, the students created prompts that were convenient for their needs *(Reflection Papers and Observation)*.

The participants identified several user-friendly GenAI features that contributed to the improvement of their technical and AI literacy competencies. They described its design as comfortable, discreet, and helpful. Students reported spending extended periods interacting with GenAI without feeling bored, and they appreciated its ability to answer their queries and provide information. GenAI's accessibility was identified as a key advantage: Most models were free to use and required no special skills.

GenAI's algorithmic capabilities

Students observed the system's ability to construct contextual awareness (i.e. the ability to track and comprehend the ongoing conversation to deliver more relevant and accurate responses). The participants recognised this capability when GenAI seamlessly understood follow-up questions related to previous inquiries. One student remarked on this aspect, appreciating GenAI's "full attention" and ability to comprehend their requests from start to finish. Another observed that GenAI provided programming-related answers to a colleague while offering math-oriented answers to her due to their respective inquiry patterns. The students thought this personalisation was similar to recommendation algorithms used by platforms like Instagram and TikTok *(Focus groups)*.

GenAI also suggested additional questions and supplemental information related to the topic at hand, stimulating students to consider new perspectives. For example, a student requesting an introduction for a research paper received not only the introduction but also research questions and methodology suggestions *(A screen recording of student presentations and assignments)*. Finally, students noted GenAI's ability to continuously improve based on user interactions and feedback.

The study participants observed a double-edged effect regarding GenAI's ability to mimic their writing style. On the positive side, GenAI's outputs maintained the student's unique style, including vocabulary choices, sentence structure, and tone. This ensured a sense of familiarity and potentially facilitated the integration of the generated content into existing work. However, this personalisation could be disadvantageous if the student wished to deviate from their usual style for specific tasks.

Chat management included two functionalities: chat history and chat sharing. First, GenAI maintained a comprehensive history of all interactions, displayed with timestamps in the browser interface, even after closing and reopening the browser. This feature allowed students to easily review past conversations and retrieve information from previous encounters. Second, GenAI facilitated collaboration and knowledge sharing by enabling users to share chat sessions via generated links. These links provided access to the conversation in real time or a static snapshot at the time of generation.

GenAI's linguistic capabilities

The students also demonstrated an understanding of GenAI's ability to generate diverse and unique text outputs. Even with identical prompts or questions, GenAI produced distinct responses for each user. This is a paradoxical strength of GenAI: Verbiage is paired with the ability to be concise. GenAI can generate detailed explanations and elaborate content, but it can also provide succinct summaries. For instance, a student said: "I received a comprehensive answer and requested a 20-word summary, which GenAI successfully delivered".

Students consistently praised the clarity and academic suitability of texts generated by GenAI, which were grammatically correct, spelt correctly, and easy to understand. This clarity was achieved through the use of a logical sequence and a readily understood vocabulary as well as the incorporation of examples and detailed explanations to effectively convey information.

Beyond text generation, GenAI demonstrated proficiency in text analysis and responded adequately to modification and proofreading commands. Students utilised this functionality to ensure the linguistic integrity (grammar, spelling), coherence, clarity, and accurate expression of their writing. Additionally, GenAI's ability to identify and eliminate redundancies further enhanced its role as a valuable linguistic proofreader capable of reformulating student writing into a sound, coherent academic style.

While acknowledging stronger English support, GenAI also supported Arabic, the students' native language, even demonstrating comprehension of commands with grammatical or spelling errors. GenAI offered real-time translation services between any language and Arabic or English upon request. Interestingly, some models, such as Copilot, exhibited cultural awareness by incorporating the "basmalah" (a Muslim invocation for blessings) at the beginning of responses (see Figure 1).

The students also observed that GenAI seemed to comprehend emotional contexts. It responded differently to writing prompts depending on the intended style, such as formal academic writing, humorous writing, or apologetic emails conveying remorse. Additionally, some students noted that certain models used emojis (e.g. a smiley face) to express emotions (e.g. happiness or relief; see Figure 1, *which is captured from a screen recording of student presentations and assignments*).

GenAI's linguistic abilities were found to extend beyond traditional text formats; it exhibited a remarkable capability for multimedia analysis. GenAI could analyse images and videos, generating detailed textual or audio descriptions and explanations, but it could also perform the opposite task, transforming written text into corresponding images, audio, or video.

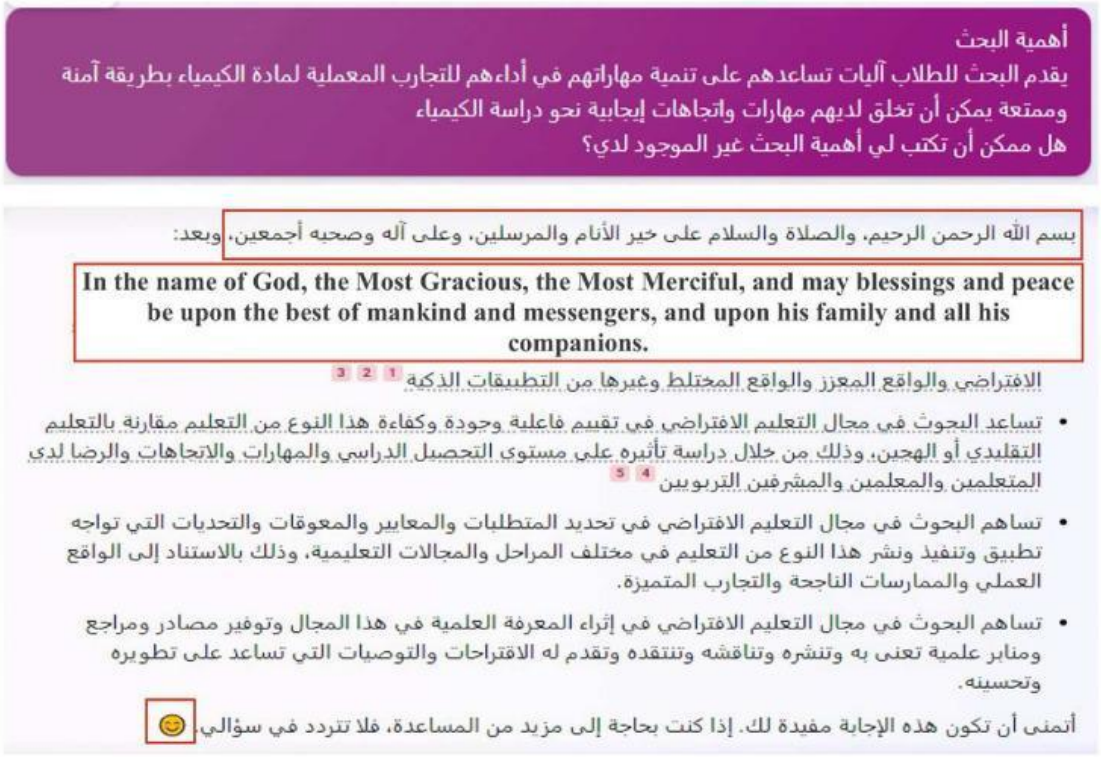

Figure 1. Copilot's use of "basmalah" and emojis.

Ethical and legal competencies

The findings demonstrated how students developed ethical and legal competencies regarding their use of GenAI through their awareness of issues related to GenAI's trustworthiness and credibility, as well as to privacy and safety.

Trustworthiness and credibility

The primary challenge faced by students when utilising GenAI in their academic endeavours was the issue of the trustworthiness and credibility of the supplied information. The most significant concern was the lack of, or inadequacy of, references. While some GenAI models offered references, students found them unreliable, noting sources such as blogs and websites of questionable repute. As postgraduate students, their needs required access to credible sources, such as peer-reviewed articles in high-ranking journals and books published by established publishers. Furthermore, students emphasised the importance of rigorous reference verification due to encountering instances of GenAI generating fabricated references. In some cases students attempted to locate the information within the references provided by the system only to discover that the information did not exist. One student summarised the issue, saying, "Failure to document the information casts doubt on its credibility".

Many students were worried about what they called "brainwashing" and "illusion creation" related to the use of GenAI. This fear stemmed from the lack of reliable sources to verify the provided information. They were concerned that misinformation from GenAI could become part of their understanding, affecting their thinking and leading them to make mistakes. They were also concerned that the widespread use of GenAI in daily life could potentially lead to machines controlling human lives.

The rapid content generation capabilities of GenAI presented a concern for some students, who worried about their potential use being misconstrued as plagiarism. The university's lack of specific guidelines regarding the use of AI-generated content in academic work created this uncertainty, which led students to hesitate to incorporate GenAI outputs into their research or assignments, fearing punishment or negative evaluation from instructors or supervisors who might perceive such use as cheating. One student explained, "I used ChatGPT for assignments that do not require references, but I prefer not to tell my instructor about it". Another student said, "I discarded an assignment I created with GenAI and decided to do it myself because I wanted to maintain my instructor's trust".

Privacy and safety

Students also raised concerns regarding privacy violations by GenAI. One student expressed a specific worry about unauthorised access to personal information on their devices: "I asked one of the GenAI models if it can view my computer files, and it said yes. This is a major concern for me."

The students also expressed concerns regarding potential copyright infringement and plagiarism associated with GenAI. One participant said, "As a postgraduate researcher, I fear using GenAI for editing might reveal my original ideas, which stemmed from my hard work of reading and thinking. I am afraid it might be shared with other users." Her classmate commented, "I provided some information to Gemini and requested editing. Simultaneously, I asked my sister to search for the same information. Surprisingly, Gemini provided her with my writing, using the same words and style" *(Focus groups)*. Additionally, students reported inconsistencies in GenAI's handling of references. In some cases, references were retained during editing but then reused in unrelated outputs. Finally, students expressed anxiety about the potential loss of copyright for images generated by GenAI, fearing that their creative prompts and the resulting visuals could be copied and used by others for assignments.

Critical thinking competencies

The findings demonstrated how students developed critical thinking competence regarding using GenAI through the techniques they utilised in their academic practices. Students treated GenAI as having four roles: collaborative learning partner, assistant researcher, proofreader, and private tutor.

Collaborative learning partner

The primary academic function attributed to GenAI by the students was that of a collaborative learning partner. Students perceived GenAI as an invaluable resource brimming with creative and inexhaustible ideas. Students frequently employed GenAI to stimulate brainstorming sessions for various assignments; during this course, when tasked with formulating presentations for the symposium, some students turned to GenAI for guidance and the generation of basic outlines for their presentations *(Observation)*.

The students also employed GenAI to write reports and prepare presentations in other courses. Notably, students reported using GenAI for reports that were less dependent on referenced sources, as opposed to research papers requiring credible citations. When students employed GenAI to generate presentation topic details, the system instead generated complete presentations, including content, visuals, design, and formatting. Notably, the students expressed concerns regarding the potential for shallow content generation with GenAI. To address this, they adopted a hybrid approach in which they provided the content and then utilised GenAI to handle routine tasks, such as design and formatting, reflecting their advances in critical thinking competence *(A screen recording of student presentations and assignments)*.

In addition, some students employed GenAI to produce multimedia components (images, audio, and video). For instance, all symposium visuals, including the invitation card (Figure 2), were generated using GenAI. Although students were appreciative of the resulting multimedia components, they expressed dissatisfaction with the pronunciation of Arabic in AI-generated videos. One student highlighted the challenge of accommodating diverse Arabic dialects, such as Saudi, Egyptian, and Algerian, explaining that the generated speech often sounded "*weird, fake, cracked, and broken*".

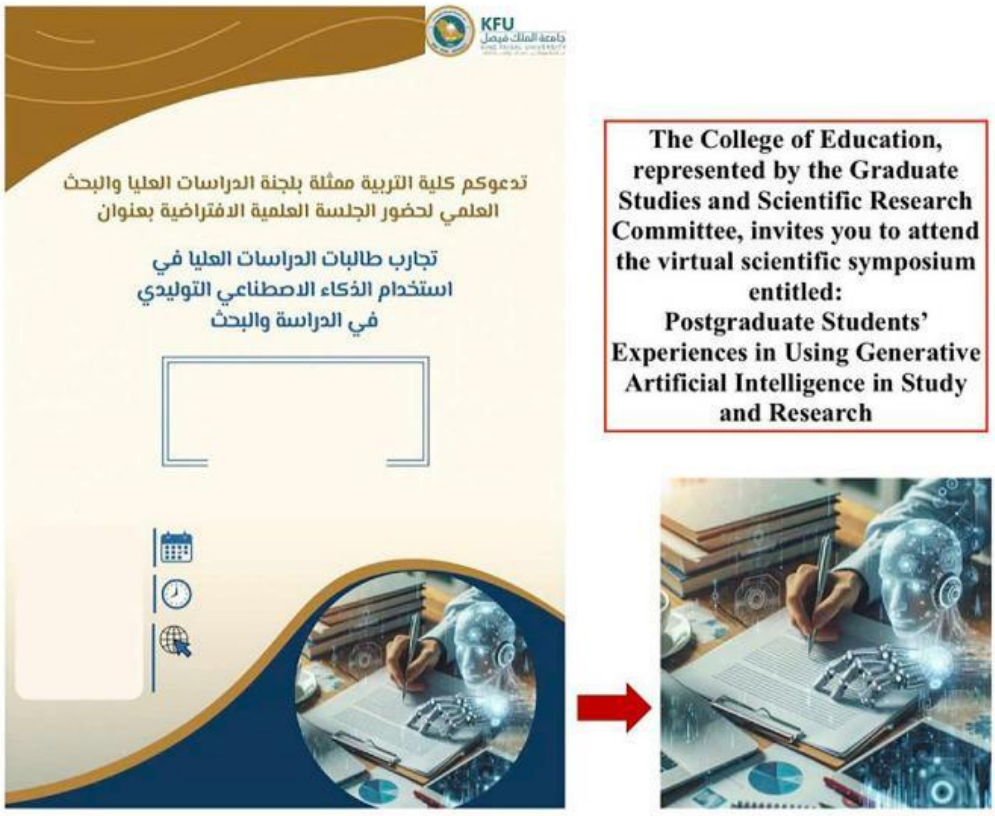

Figure 2. The invitation's image was generated using GenAI.

Research assistant

Given the critical role of research in their academic pursuits, the students employed GenAI as a research assistant. Recognising their limitations as junior researchers, the students primarily utilised GenAI to generate research ideas, identify current trends within their fields, and craft titles, research questions, and hypotheses that accurately reflected their research objectives.

During the literature review stage, the students used GenAI to structure their research outlines, locate relevant references, synthesise research articles, and identify essential keywords. This allowed them to refine their searches in trusted digital libraries. One student commented, "The keywords and background information provided by GenAI give me the foundation to conduct better searches on Google Scholar". Some students admitted to using AI-generated text as a starting point for writing, followed by a search for supporting references. This approach, in contrast to traditional research methods of locating, reading, summarising, and rephrasing existing sources, highlights a potential shift in information gathering and utilisation. GenAI also aided students in designing data collection methods and instruments and in constructing and refining survey statements and interview questions. Finally, students employed GenAI in research discussions to assist in interpreting and explaining their findings. They reported time savings, as GenAI provided information and generated content faster than traditional methods, such as book research or web searches, and provided relevant links.

While the students initially valued GenAI's role as a research assistant, they observed limitations in the quality of the research papers it produced. This became evident during an assignment in which students compared three research papers on the same topic: (1) an AI-generated paper with student input, (2) a student-written paper without GenAI assistance, and (3) a GenAI-paraphrased version of the student's paper. The exercise revealed several shortcomings in GenAI's capabilities. First, regarding accuracy and scientific rigour, the student-written paper demonstrated superior accuracy and scientific grounding compared to the AI-generated paper, which contained numerous scientific errors. Second, regarding depth of content, the AI-generated paper lacked depth and comprehensiveness in its treatment of scientific information. Third, GenAI struggled to paraphrase long sections, forcing students to submit content in smaller segments for processing *(A screen recording of student presentations and assignments and focus groups)*. Several students discovered that GenAI often repeated information in different words, even when they changed their prompts. To avoid this, they sometimes started a new chat with the same model or switched to another one in an attempt to generate more varied or novel responses.

Proofreader

The students utilised GenAI as a proofreader in two ways, to correct spelling and grammatical errors and to paraphrase their writing. GenAI addressed limitations in writing skills by rewriting drafts with a more academic tone and by minimising the risk of unintentional plagiarism by suggesting alternate words and linguistic structures. Additionally, GenAI identified repetitive phrases, reduced word-counts in certain instances, and provided a free proofreading service. While most students felt that GenAI paraphrasing offered improved results, one student expressed a preference for her original composition, citing the presence of a "human soul" within it (both versions were in Arabic) *(Observation)*.

Private tutor

Students viewed GenAI as a versatile "private tutor" that provided various academic support functions (teaching, assessment, and counselling). They frequently sought clarifications on concepts, vocabulary, and complex ideas and appreciated the clear explanations and supporting examples offered by GenAI compared to traditional methods like YouTube searches. Furthermore, students utilised GenAI to clarify assignment instructions, ensuring proper understanding and execution. GenAI also provided detailed assignment feedback, allowing students to improve their work (e.g. verifying

referencing formats). Finally, some students consulted GenAI to overcome academic challenges, set goals, and develop strategies for success.

Lifelong learning and interpersonal competencies

This course, designed using a PAR approach, initially aimed to develop students' competencies regarding ethically integrating GenAI into academic practice. However, the learning process took an inspiring turn when the students began to envision empowering society with GenAI knowledge. The students did not limit their learning to what was taught in class; they read articles, watched videos about the latest developments in GenAI-related technology, and shared them in the course's Telegram group, thereby enhancing their lifelong learning skills *(Telegram group content)*.

Additionally, the students did not restrict their GenAI skills to personal benefits – they also expressed interest in developing such competencies of society in general. Several students were teachers, so they utilised their GenAI knowledge, experiences, and competencies in their teaching practices. One student said, "I use GenAI to create show slides for my lessons. It saved my time." Another student sought advice on parenting practices for infants, and a third taught her son how to ethically use GenAI for homework assistance. The participants expressed a strong interest in educating a broader audience. In response, the symposium project, which aimed to equip the wider community with GenAI skills and knowledge, was introduced as the course's culminating assignment. However, the project's reach exceeded expectations: The symposium was livestreamed on Zoom, YouTube Live, and X, and it attracted a global audience exceeding 1,000 attendees. The symposium assignment catalysed the development of a range of student skills beyond GenAI expertise (e.g. presentation and delivery, negotiation, and teamwork), and the final results garnered audience praise *(Symposium content)*.

The most effective strategies for developing postgraduate students' GenAI competencies

Students mentioned that the use of the PAR approach was an effective way to develop their competencies. The lectures were recorded and promptly shared with students via the BlackBoard platform. This allowed them to watch themselves learn and work with GenAI and then consider what they observed. During the lectures, there were ongoing and in-depth discussions about students' experiences, activities in and out of class, and assignments. These discussions served as opportunities for reflection and guidance in planning future lectures. At the end of each lecture, I asked students what they wanted to learn next and what they still felt they needed to know about GenAI *(Reflection Papers)*.

Beyond lectures and discussions, the PAR approach fostered student engagement through self-learning, collaborative learning, and peer learning. The students actively pursued additional knowledge through various methods, including directly asking GenAI about its functionalities, exploring YouTube videos on GenAI, following social media accounts dedicated to GenAI, and attending online workshops. Additionally, the students embraced a trial-and-error approach. For example, one student described studying other users' prompts for generating images with GenAI – by translating existing prompts from English to Arabic, she gained insight into the system's operation *(Focus groups)*. This newfound understanding empowered students to formulate their prompts and achieve the desired image outputs.

The participants fostered a collaborative and supportive learning environment by actively sharing knowledge. They utilised the course's private Telegram group to share resources (e.g. links to online workshops) *(Telegram group content)*. Students with prior GenAI experience assisted their peers with technical challenges, such as logging in for the first time. The course assignments themselves were designed to encourage teamwork, and the symposium project provided a powerful platform for collaborative learning (students worked together on a single cohesive presentation using the Canva platform).