Learning With Generative Artificial Intelligence in Collaborative Problem Solving: A Teaching and Learning Framework for Entrepreneurship Education

Jobert Ngwenya, University of Oulu, Finland

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Abstract
The development of generative Artificial Intelligence (Gen AI) tools has led to different reactions in the field of education arising from both the opportunities and challenges that these tools pose to learning. However, not much is known about how to effectively implement these tools in teaching and learning processes. This study, which followed an action design research methodology, a "learning with Generative AI framework" was developed, implemented, and evaluated in the context of collaborative problem-solving in entrepreneurship education. A literature review was conducted analysing seven articles and two books published between 2022 and 2024. With insights from the T-PACK framework, human-centred design, and human-AI collaboration a framework was built. The evaluation of the framework involved fifteen University of Oulu and Oulu University of Applied Science students participating in a series of Generative AI in Business Processes workshops and three expert evaluators from two universities assessing the framework. Results of this study show that generative AI tools present both challenges and opportunities for learning yet, following a structured approach suggested by the framework, the challenges can be minimised, leveraging the opportunities, to facilitate teaching and learning with generative AI. Creativity, problem-solving, and collaboration can be enhanced by the purposeful integration of generative artificial intelligence tools in teaching and learning. The study concluded that, with human agency remaining central, generative AI tools can be successfully integrated into collaborative problem-solving learning situations in entrepreneurship education using the proposed learning framework.

Keywords: Generative Artificial Intelligence, Collaborative Problem Solving, Entrepreneurship Education, Human-AI Collaboration, AI Literacy

Introduction

Generative Artificial Intelligence (Gen AI) has brought new dimensions to education, necessitating innovative approaches to bridge the gap between traditional pedagogical theories and the demands of the future job market. Generative AI can generate content or output such as text, images, audio, simulations, video, and codes (Eke, 2023), so the teaching and learning process needs to evolve to incorporate these technologies.

Although there have been fears around academic integrity issues and achievement of learning goals (Sullivan, et al., 2023), generative AI tools present a transition from technology-based learning to learning with technology (Daia et al., 2023). The former refers to the technology used to support learning to understand concepts while the latter is framed by a cognitive, social-constructivist paradigm where the technology becomes part of the knowledge co-construction process (Niederhauser, 2013).

As the hype associated with the launch of Chat GPT in late 2022 was fading away, questions on how these technologies were to be integrated into teaching and learning processes arose. This study therefore sought to design a learning framework that enhances the integration of generative artificial intelligence in the teaching and learning process without undermining academic integrity and compromising human agency and creativity.

Literature Review

Generative Artificial Intelligence in Education

Generative AI is a new form of artificial intelligence that focuses on generating human-like, novel content and data from human prompts producing text, images, audio, video, and multi-modal files (Cress & Kimmerle, 2023; Winkler, et al., 2023). Although without any conceptual knowledge or world understanding and can produce information that lacks truth and validity, these tools present a lot of opportunities and challenges to the teaching and learning process. From automated essay scoring to personalised tutoring, research assistance, classroom support, language translation, and skill development, it revolutionises the learning experience, empowering educators, and students alike to thrive in the dynamic landscape of education (Atlas, 2023).

The main challenges with the introduction of generative AI technologies have been concerns regarding the unethical use of these tools, misrepresentation of work by learners, and academic merits without active participation in the learning process. It is for this reason that instead of shunning the usage of these tools, a shift towards embracing generative AI as a contemporary educational technology and integrating it into pedagogical principles is important (Chang, et al., 2023). Collaboration among teachers, instructional designers, education researchers, and AI developers is therefore crucial to spell out the best practices in the utilisation of these emerging technologies.

With the proliferation of these tools, a shift in teaching and learning practices is called upon. Doyle, (2023), suggests that new practices should include “fostering inquiry-driven learning, cultivating critical thinking, enhancing the curriculum with adaptive content and assessment, stimulating creativity and innovation through AI prompts and simulations….” In the problem-solving process, identifying and understanding the problem to develop a relevant and effective solution is key (OECD, 2012) a process that can be expediated using generative

AI tool (Bail, 2023). Generative AI tools can be useful in helping students in inquiry-based learning as they give them access to tonnes of information that is accessible on the go in the digestible format.

Formal training of teachers to integrate generative AI into their practice is critical (Kim et al., 2022). According to OECD, (2023), there is a need to work with educators through experimentation in using generative AI since there is presently no evidence to support learning with generative AI. To benefit from the human-AI collaboration, clear communication from the human factor is particularly important. Educators must be trained to effectively guide the usage of these tools in processes such as asking questions, expressing thoughts, and constructing arguments while interacting with generative AI agents (Vasconcelos & dos Santos, 2023).

In addition, generative AI capabilities are transforming the role of the teacher. Because these tools can offer personalised guidance to individuals in a learning environment, teachers can be very instrumental in bringing relevant personal stories and experiences that may trigger cognitive, metacognitive, and motivational processes among students (Koh, 2023). Therefore, the teacher may use the same AI tools to get guidance ideas for group and individual guidance shifting the role of the teacher from the traditional to the guide-by-side role. With all the potential benefits and challenges that generative AI tools present to the education sector, a balanced approach to its integration into the teaching and learning processes is therefore paramount.

Collaborative Problem-Solving in the Age of Generative AI

Collaborative problem-solving (CPS) occurs when individuals combine their understanding and efforts to solve a problem (OECD, 2012). It is defined as a coordinated, synchronous activity stemming from a shared problem understanding to co-construct a solution (PISA, 2017). CPS has gained momentum as it equips learners with work-life skills. Ouyang (2023) states that CPS is grounded in Vygotsky's (1978) social and situated perspectives of learning, fostering active learning and triggering interactive, cognitive, behavioural, and socio-emotional aspects of learning.

Different dynamics occur during CPS, including interactions among students, between students and groups, and with the learning environment and artefacts (Stahl & Hakkarainen, 2021). The problem-solving process involves clear problem identification (Nelson, 1999), deepening understanding, generating and evaluating potential solutions (Jiang et al., 2023), reaching a consensus, and developing an implementation plan (Chen et al., 2019). This structured approach ensures comprehensive and effective problem resolution.

Social interactions during CPS help develop learners' zone of proximal development. Zhang et al. (2019) suggest that computer-supported CPS may promote collective intelligence and distributed cognition (Stahl & Hakkarainen, 2021). Socio-emotionally, CPS fosters listening, empathy, participation, and cohesive groups, leading to active engagement and social motivation (Ouyang et al., 2023).

Generative AI significantly impacts CPS in learning and work. AI tools, though not conscious, can communicate like humans and be considered true collaborators. Tools like ChatGPT and Bing Chat help develop reflective thinking, creativity, problem-solving skills,

and concept comprehension, fostering engagement and deep understanding (Vasconcelos & dos Santos, 2023).

Different student-AI interactions, including cognitive, socio-emotional, and artefact-mediated types, are crucial in collaborative learning and problem-solving (Stahl & Hakkarainen, 2021). Cognitive interactions focus on task-related knowledge processing, socio-emotional interactions shape the emotional climate, and interfaces play a pivotal role in interaction quality (Vincent-Lancrin & van der Vlier, 2020). These interactions impact learning experiences and outcomes, making AI tools significant co-creators with humans, triggering cognitive, emotional, and motivational states. Beyond human-to-AI interaction, students ask questions, exchange information, and trigger each other's contributions and reflections (Cress & Kimmerle, 2023). Learners using AI tools become active, constructive, and interactive, leading to higher-order learning activities. Collaborative problem-solving involves students and generative AI tools as co-constructors of knowledge and solutions to real-world problems, with AI tools playing a key role as partners in the process.

Entrepreneurship Education and Generative AI

Entrepreneurship education builds skills like creative thinking, problem-solving, innovation, new product development, negotiation, and leadership (Kuratko, 2005). Effective teaching methods include industry visits, interactive lectures, and ideation activities (Samsudin, 2019). Learning for entrepreneurship involves action-based collaborative learning, with educators acting as facilitators (Kujala et al., 2021). Partnerships with external mentors foster an entrepreneurial mindset (Jackson et al., 2023; Hadley, 2023).

High school entrepreneurship education should focus on experiential learning grounded in 21st-century competencies (Hadley, 2023). Educators should prioritise skill development, value co-creation, and relevant learning environments (Hadley, 2023). Students should focus on skill acquisition, active engagement, and collaborative value creation (Kujala et al., 2021). Less formal settings encourage responsibility, teamwork, and social learning (Hartikainen et al., 2021).

Generative AI tools are useful in various business domains and can aid in the entrepreneurial process (Winkler et al., 2023). However, students should also engage with stakeholders within the entrepreneurship ecosystem (Dermol, 2019).

Entrepreneurship education aligns with collaborative problem-solving, using generative AI tools as partners in generating ideas and creating content.

Socio-Technical Theory and Generative AI in Education

Socio-technical theory emphasises the interrelation of social and technical factors in organisations (Sony & Naik, 2020). The theory, originating in the 1950s, highlights the importance of humans as resources and encourages collaboration and innovation (Abbas & Michael, 2023). The interaction between social and technical systems leads to organisational success (Walker et al., 2008).

In the context of generative AI, social constructivism emphasises the role of social interaction and collaborative learning (Vygotsky, 1978). Learning is a social activity involving feedback and mentoring (Nelson & Erlandson, 2012). This research integrates generative AI in the

learning process to achieve learning goals through human-to-human and human-to-AI collaboration. The socio-technical theory aligns with design science research methods to optimise the learning process (Cronholm & Gobel, 2022). This research follows the action design research approach, emphasising social and technical collaboration.

Research Aim

This research contributes to the "evolution of education" by providing educators with a blueprint for effectively merging generative AI tools in entrepreneurship education to equip students with collaborative problem-solving and AI literacy skills in the process of "learning with AI" while maintaining sound pedagogical practices.

Research Questions

a. What are the features of generative AI tools that pose threats and opportunities for teaching and learning?
b. What components can be included in collaborative problem-solving Learning with Generative AI Framework in entrepreneurship education?
c. How useful is the proposed learning framework in collaborative problem-solving in entrepreneurship education?

Methodology

Action Design Research (ADR) Methodology

This research used action design research (ADR), a subtype of design science research (DSR) popular in information technology (Adam, 2021; Sein et al., 2011). ADR blends design research with action research (Petersson & Lundberg, 2016) to generate prescriptive design knowledge through building and evaluating IT artefacts in organisational settings. It aims to design tangible solutions or artefacts to solve complex problems (Sammon & Nagle, 2023). This method aligns with socio-technical theory and meets the research objectives of integrating generative AI in learning.

Stage 1: Problem Formulation.

The problem formulation stage involved exploring literature on pedagogical theories, generative AI in education, collaborative problem-solving, and entrepreneurship education. This stage focused on existing knowledge to build a framework for teaching and learning with generative AI (Petersson & Lundberg, 2016). The literature review assessed the potential and challenges of generative AI, emphasising its features and impact on learning (Knopf, 2006).

Stage 2: Building, Intervention and Evaluation.

This stage involved developing the "Learning with Generative AI" framework, evaluated in real learning settings and through expert evaluation. The framework was applied in entrepreneurship education workshops with 15 participants using various generative AI tools. Data was collected through observations, focus group discussions, artefact analysis, and questionnaires to evaluate the framework's utility, efficacy, and areas for improvement (Venable et al., 2012).

Stage 3: Reflection and Learning.

Reflection and learning ran parallel to other stages, involving continuous literature review and data analysis. Feedback from participants and expert evaluations was used to improve the framework. The iterative process emphasized the importance of human agency in learning and the non-linear implementation of the framework in real environments (Bilandzic & Venable, 2011).

Stage 4: Formalisation of Learning.

The final stage involved generalising research outcomes and connecting them with underlying theories. Insights from literature and data analysis were juxtaposed against research questions to determine the applicability of lessons learned in other scenarios. Limitations and areas for future research were highlighted.

Participants and Setting

A naturalistic field study was conducted with 15 students (8 females and 7 males) from the University of Oulu and Oulu University of Applied Sciences, selected for their membership in the Oulu Entrepreneurship Society (Creswell, 2009). The natural setting was chosen based on recommendations by Cresswell (2009) and Venable et al. (2012). Evaluation occurred during the deployment phase (Li et al., 2024) through three workshops on business ideation, validation, and pitching, co-facilitated by the researcher and an entrepreneurship educator. Data was collected after each session and the series.

Three expert evaluators in education sciences, business management, and marketing, with experience in teacher training and entrepreneurship education, conducted a second evaluation. Participants were informed about the research process, and participation was voluntary with informed consent. Data was anonymised and later destroyed after the completion of this research.

Data Collection and Analysis

The research process was iterative, hence data collection, analysis, and interpretation throughout the process. Qualitative data was collected through literature review, observations, focus group discussions, questionnaires, and reflection notes. Data sets from the different participants were thematically analysed by initially organising and preparing, reading the data, and developing codes before creating themes which were then grouped and interpreted based on the research aim of producing an effective and usable artefact (Creswell, 2009).

The LASTING IMAGE Framework

This research examined the threats and opportunities of generative AI in education, focusing on building a framework for entrepreneurship education in collaborative problem-solving.

Problem Formulation

To identify the features of generative AI tools that pose threats and opportunities for teaching and learning, recent literature was reviewed. Generative AI offers novel opportunities for

personalised, quality learning experiences, addressing educational gaps (OECD, 2023). These tools provide instructional scaffolding and "learning mate" attributes, benefiting both educators and students by offering personalised, 24-hour education (Kim et al., 2022).

Generative AI tools offer significant opportunities for overcoming language barriers and providing high-quality instructional material, especially in remote areas (OECD, 2021; Baskara, 2023). They enable personalised learning experiences, benefiting students from low socio-economic backgrounds and those needing targeted interventions (OECD, 2023). AI tools can enhance human intelligence, fostering creativity and independence (Kim et al., 2022). They also support educators by reducing workload and offering better assessment pathways (Vincent-Lancrin & van der Vlies, 2020).

However, generative AI tools present challenges, such as biases and the potential for producing inaccurate information (Piskopani et al., 2023; Sullivan et al., 2023). Overreliance on these tools can negatively impact students' innovative capacities and collaborative learning (Darvishi et al., 2023). Therefore, careful integration of AI in education is essential to maximise benefits and mitigate risks (Chan, 2023).

A framework was developed to assist teachers in integrating generative AI in collaborative problem-solving within entrepreneurship education. It is based on human-centred design (Giacomin, 2014), collaborative learning (Laal & Laal, 2012), hybrid intelligence (Bredeweg & Kragten, 2022), and the TPACK Framework (Mishra et al., 2023). This framework supports educators in integrating generative AI, considering AI tools as co-members of the learning process.

The framework highlights the teacher's role in integrating generative AI tools, promoting collaborative learning, and leveraging a learning community for entrepreneurship education. Teachers facilitate learning, while students use AI tools in groups, supported by the learning community. The teacher's role includes illustrating AI tool use and providing domain knowledge.

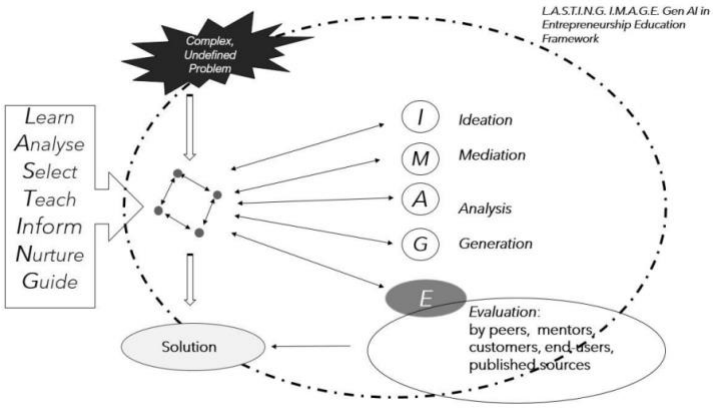

Figure 1: LASTING IMAGE Framework

The acronym LASTING outlines the teacher's responsibilities: learning about AI, assessing tools, selecting appropriate ones, teaching AI literacy, informing students, nurturing AI skills, and guiding students (Davis, 1989; Baylor & Ritchie, 2002; Sharples, 2023; Kolb, 1984; Koehler & Mishra, 2016; Nelson, 2017; An et al., 2022).

The acronym IMAGE represents the student's use of AI tools: ideating, moderating ideas, analysing data, generating content, and evaluating information. Continuous evaluation and peer assessments are crucial for refining ideas and ensuring human agency (William, 2017; Houston, 2020; Hattie & Timperley, 2007; Bason, 2017).

Implementation Steps.

Teacher: a. *Learn* about and with generative AI. b. *Assess* the best generative AI for your situation. c. *Select* and familiarise yourself with the best tools. d. *Teach* students about AI's pros and cons, privacy, and ethics. e. *Inform* students with domain and contextual knowledge. f. *Nurture* AI literacy and encourage human agency. g. *Guide* students during learning.

Students: a. Use tools for *ideation*. b. Use tools to *moderate* ideas. c. *Analyse* data with tools. d. *Generate* content with tools. e. *Evaluate* problems and solutions with tools and the learning community.

Framework: Detailed Explanation.

Generative AI redefines teachers' roles from content delivery to facilitating learning and addressing AI literacy (Baskara, 2023; Kali et al., 2015; Nakata & Jarvenoja, 2023). Teachers must *learn* and be AI literate to effectively integrate AI into education (Chaudhry & Kazim, 2021; Cress & Kimmerle, 2023; Kohnke et al., 2023; UNESCO, 2023; Chan, 2023).

Teachers should *assess* AI tools to meet learning needs and goals, considering local needs and ethical use (UNESCO, 2023; Doyle, 2023; Koh et al., 2023; Chan, 2023). *Selecting* the right tools is crucial for effective teaching (dos Santos, 2023; Vasconcelos & dos Santos, 2023). *Teach* students about AI's pros and cons, privacy, and ethics (Kaplan-Rakowski et al., 2023; Baskara, 2023).

Teachers *inform* students about domain knowledge and trends, enhancing critical thinking and effective use of AI tools (Saracho, 2002; Calderon & Cardoso, 2023; Vasconcelos & dos Santos, 2023). *Nurturing* involves personalised mentorship and maintaining personal interactions (Verenikina, 2008; Kohnke et al., 2023; Bulger, 2016; UNESCO, 2023; Koh, 2023).

Guiding includes ethical AI usage, privacy, data security, and bias (Bray, 2012; Albadarin et al., 2023; Vasconcelos & dos Santos, 2023). Proper prompting and responsible use are essential for desired outcomes.

In the process of *ideation* generative AI tools can inspire creative thinking by providing novel perspectives during brainstorming sessions (OECD, 2023). Proper prompting helps students frame their ideas effectively. Generative AI can *mediate* during collaborative problem-solving, breaking deadlocks and supporting teamwork (Cress & Kimmerle, 2023; Koh, 2023). It promotes inclusion, equity, and cultural diversity (UNESCO, 2023).

AI tools can *analyse* large amounts of data, saving time and reducing cognitive load (Bail, 2023). They are useful for processing interview notes, questionnaires, and focus group data. Generative AI can *generate* or create text, audio, images, and videos, aiding students in generating materials like interview questions and advertisements without relying on experts.

AI tools can provide an *evaluation* and provide feedback and suggestions, aiding in product validation (OECD, 2023; Doyle, 2023). Human evaluation remains crucial to ensure the quality and relevance of ideas (UNESCO, 2021, 2023).

Summary.

For successful AI integration, teachers must adapt by learning and teaching about AI, supporting AI processes, and providing domain knowledge. Generative AI should augment, not replace, human intelligence, with students using AI for brainstorming, moderation, analysis, content creation, and evaluation, while maintaining human oversight.

Intervention and Evaluation of the LASTING IMAGE Framework

Framework Testing in a Natural Learning Environment

The initial framework was tested in a natural learning environment with the Oulu Entrepreneurship Society. Data from observations, artefact analysis, focus group discussions, and questionnaires highlighted the need for more domain knowledge and effective use of generative AI tools. Participants, mostly university students, required more AI literacy and prompt engineering skills. Feedback indicated the importance of AI literacy and the supportive role of the learning community. Participants valued the involvement of peers, facilitators, and stakeholders, which enhanced their learning experience and entrepreneurial skills.

Framework Testing: Experts Evaluation

After initial testing, the framework was adjusted and evaluated by experts in learning sciences, business studies, and marketing. The evaluation focused on theoretical foundations, design, integration of entrepreneurship, generative AI, collaborative problem-solving, usability, and teacher support. Feedback was categorised into themes, highlighting strengths, weaknesses, opportunities, and threats. Expert views were incorporated into the final version of the framework, reflecting the iterative process of development and evaluation.

Discussion

Reflection and Learning

This research explored the use of generative AI tools to develop students' collaborative problem-solving skills in entrepreneurship education. The "Learning with Generative AI Framework" was evaluated and found to successfully integrate generative AI in teaching entrepreneurship through a collaborative problem-solving model.

The framework's development involved problem formulation, building, implementation, and evaluation, showing that successful integration of generative AI can be achieved through learning about AI, learning from AI, and learning with AI (Kim & Cho, 2022). The first evaluation revealed that learners appreciated using generative AI ethically and gained AI literacy and domain knowledge.

Generative AI tools enabled students to work more efficiently, reducing cognitive load by handling mundane tasks (Sweller, 2011). This allowed students to focus on more complex

tasks, improving their preparation and presentation of pitches. Generative AI provided quick access to information and ideas, enhancing the collaborative problem-solving process (OECD, 2023; Vasconcelos & dos Santos, 2023).

The framework encourages interaction between students and AI tools, promoting co-construction of knowledge (Cress & Kimmerle, 2023; Kim et al., 2022). It aligns with social constructivist theory, emphasising the importance of interactions in knowledge development (Roth, 2000). Contrary to initial assumptions, the research highlighted the significant, albeit changing, role of the teacher. Generative AI tools transform learning by providing instant feedback and simplifying technical tasks, but human indispensability remains crucial (Koh, 2023).

The framework emphasises AI literacy for both educators and students, highlighting the importance of prompt writing skills (Yilmaz et al., 2023). Teachers must adapt to new roles, collaborating with AI tools to enhance teaching and learning (Mishra et al., 2023). The "Learning with AI" Framework acknowledges the strengths and weaknesses of AI tools and the indispensability of human agency.

Formalisation of Learning

Generative AI tools present both opportunities and challenges in education. This research shows that with deliberate efforts, these tools can be seamlessly integrated into classrooms without compromising academic integrity. Despite challenges, generative AI tools are becoming integral to work-life, necessitating AI literacy through teacher training and cascading knowledge to students for future skills.

Generative AI tools foster collaboration and personalised learning, boosting learner confidence and outcomes (Wu, 2023; Schunk & DiBenedetto, 2016). They save time and improve efficiency in teaching, supporting diverse learners, including those with special needs (Javid et al., 2023). Proper use of these tools reduces cognitive load, enhancing learning experiences (Gandhi et al., 2023; Ritz et al., 2024).

AI tools provide social interactions and cultural contexts, though biases remain a concern (Morch & Anderson, 2023; Javid et al., 2023). Ethical issues like inaccurate information and biased content must be addressed, but generative AI can support domain-specific learning environments (Su & Yang, 2023). Integrating generative AI in education prepares students for AI-dominated work environments. AI literacy is crucial for teachers and students, requiring ongoing professional development (Kong & Yang, 2024). Misuse of AI tools can undermine critical thinking and creativity, highlighting the need for hybrid intelligence to balance human and AI strengths (Wu, 2023; Doshi & Hauser, 2023; Dellermann et al., 2019; Zhou & Lee, 2023).

Conclusion

This research highlights the theoretical, methodological, and practical implications of generative AI tools in education. Generative AI presents both challenges, such as ethical concerns, bias, and false information, and opportunities, including content creation, idea generation, analysis, and tutoring. With a structured approach, these tools can enhance learning experiences.

The developed framework, based on generative AI features, proved useful in integrating AI into entrepreneurship education. It employs a human-on-the-loop approach, placing teachers at the forefront and promoting collaborative learning. This framework also supports AI literacy, creativity, and communication skills, showing that AI tools can be co-members in collaborative problem-solving without undermining human agency.

Action design research, grounded in socio-technical theory, was effectively used in this study, demonstrating its applicability in educational research. This interdisciplinary approach can help develop impactful educational solutions. The framework provides a structured method for integrating generative AI in education, maintaining the integrity of learning and emphasising the teacher's role in AI literacy and guidance.

Ethical Considerations

Ethical considerations were integral to this research, ensuring no harm to participants. The study adhered to guidelines from the Finnish National Board on Research Integrity and the EU General Data Protection Regulation, with necessary approvals and informed consent from participants.

Limitations and Further Research

This research did not address the long-term cognitive impact of generative AI tools. Further studies are needed on the cognitive effects, motivation, and emotion in learning with AI. Domain-specific AI tools should be developed and evaluated. Additionally, further research on teacher attitudes and student motivation in using generative AI is recommended.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

The author used Copilot a generative AI tool to summarise sections of this paper to align with the number of words expected for this conference paper.

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Contact email: jobert.m.ngwenya@jyu.fi