Generative AI in Reflective Learning: Bridging Literacy Gaps

Jonas Frendrup, Brian Hvarregaard, Camilla Gyldendahl Jensen, Lars Funck Kristensen, Lasse Christiansen & Henning Thomsen
University College of Northern Denmark
DOI: https://doi.org/10.54337/ecrpl25-10934

Abstract

In further education, barriers to scientific knowledge often arise due to limited competence in reading and comprehending complex academic literature. This study investigates the potential of generative artificial intelligence (AI) to scaffold reflective practice-based learning by assisting learners in overcoming these barriers by embedding generative AI within professional training. This research highlights a pathway for re-engaging adult learners with academic discourse, offering scalable solutions for lifelong learning in an era of rapid technological change. Specifically, we explore whether generative AI can enhance the accessibility of scientific literature, thereby supporting professional development through improved technological literacy. The research employed a mixed-methods approach, combining questionnaires and semi-structured interviews. The questionnaire assessed the learners perceived difficulty in engaging with academic papers. At the same time, the interviews delved into the effectiveness of generative AI assistance and its integration into their professional practice. Initial findings suggest that generative AI can act as a scaffolding mechanism, providing simplified translations and interpretations of complex texts. This support helps learners to understand and apply scientific content in their contexts. These results highlight the potential of generative AI in enhancing reflective practice-based learning by bridging gaps in scientific literacy, ultimately contributing to the future of practice-oriented education in an era shaped by disruptive technologies.

UCN UNIVERSITY COLLEGE OF NORTHERN DENMARK

Keywords
Generative Artificial Intelligence; Reflective Practice-Based Learning; Scientific Literacy; Technological Literacy; Lifelong Learning; Adult Education; Cognitive Scaffolding.

Introduction

Engaging critically with scientific literature in contemporary professional education is fundamental for fostering reflective and evidence-based practice. However, many adult learners, particularly those returning to education after years of professional experience, encounter significant barriers when faced with the complexity of academic texts (Stiglic et al., 2023). These challenges are not solely rooted in scientific literacy but also in the broader difficulty of navigating across domains and languages (Laal & Laal, 2012; Oriji & Uzoagu, 2019; Storey & Wagner, 2024). Learners must often bridge the gap between academic theory and professional practice, between general research findings and specific local or disciplinary contexts. In the context of reflective practice learning (RPL), engaging with academic literature is not just an academic skill but a central component of professional development and identity formation. Theory and academic texts within RPL are not static or abstract but deeply contextual and dialogic. To work meaningfully with theory, students must critically engage with academic texts as tools for sense-making, transformation and reflection. However, this engagement is often complicated by barriers such as linguistic challenges and registers, mainly when English-language literature is applied in non-English speaking professional environments. Developing the capacity to navigate academic literature, therefore, becomes essential for working with theoretical content as knowledge-in-action. In this understanding of RPL, it is not enough to just read the text; instead, the student must question, reinterpret and apply theoretical insights in authentic professional contexts, supporting a kind of epistemic agency, critical reflection and lifelong learning that RPL seeks to cultivate. As the demands for continuous professional development intensify in the face of rapid technological and societal change (Cacicio & Riggs, 2023), the limitations imposed by these cross-domain and cross-language challenges pose a significant threat to the effectiveness of lifelong learning (Laal & Laal, 2012). Practitioners risk falling behind in adapting to evolving professional standards and practices without

the ability to translate and transfer knowledge across these boundaries. In parallel, the emergence of generative artificial intelligence (AI) offers new opportunities for supporting learners in overcoming such barriers (Lee & Palmer, 2025). illustrates, AI is often integrated into professional tasks without being explicitly addressed, leaving learners unprepared to reflectively engage with AI tools for tasks like translation, information analysis or scientific reading (Cacicio & Riggs, 2023; Li et al., 2024). While AI has increasingly been integrated into educational contexts, its potential as a scaffolding mechanism (Lee & Palmer, 2025; Shanto et al., 2025) to support reflective practice-based learning in professional development remains underexplored. Generative AI's capacity to translate, simplify, and adapt knowledge (Cacicio & Riggs, 2023) across domains and languages presents a promising pathway for re-engaging adult learners (Li et al., 2024) with academic knowledge and enhancing their technological literacy (Joshi, 2025). However, unlocking this potential is contingent on more than just access to AI tools; it requires learners to develop the technological literacy necessary to engage with AI critically and confidently (Cacicio & Riggs, 2023; Storey & Wagner, 2024). As AI systems become deeply embedded in professional workflows, learners must move beyond surface-level familiarity and acquire a reflective understanding of how these tools function, what assumptions they make, and where their limitations lie (Lee & Palmer, 2025; Stiglic et al., 2023). Without this foundation, learners risk becoming passive recipients of AI-generated information, relying on outputs without questioning their relevance, accuracy, or appropriateness, especially when interpreting complex scientific literature (Stiglic et al., 2023; Storey & Wagner, 2024). Such uncritical use weakens reflective practice and may contribute to the misapplication of knowledge in professional settings (Storey & Wagner, 2024). In contrast, learners who develop technological literacy are better positioned to exercise professional judgment regarding when and how to apply AI effectively and, equally important, when not to. This knowledge empowers them to use AI as a catalyst for learning (Shanto et al., 2025) rather than a crutch, enabling them to actively interrogate AI-generated outputs and integrate them meaningfully into their reflective practice. Technological literacy fosters learner confidence and agency by reducing blind trust in AI systems and unwarranted scepticism, promoting a balanced and responsible engagement with technology (Lee & Palmer, 2025). This study investigates the research question: *"Can generative AI*

bridge the gap between learners and scientific literature and the broader gaps that emerge when crossing domains and languages in professional learning?"

Using a mixed-methods approach, we combine questionnaire data on learners' challenges with academic texts and semi-structured interviews exploring the value and integration of AI tools in professional contexts based on the Kirkpatrick framework (Kaufman, 1996). The data is based on learners attending an AI course. Our findings contribute to the growing discourse on the role of AI in education, offering insights into how generative AI may be leveraged to advance reflective practice-oriented learning in an era defined by technological transformation (Joshi, 2025).

Methods

To provide a meaningful context for the research, this section outlines the design and delivery of the AI course from which the study draws its empirical foundation. The aim is not to evaluate the course itself, but to describe the educational setting, purpose and core activities in which the data were generated. The section offers insight into the learning environment that shaped participants' experiences with generative AI and reflective practice by presenting the didactic design, intended learning outcomes and learning activities.

Flyvbjerg (2006) emphasises that selecting case studies should facilitate an in-depth understanding of events and phenomena within their natural and holistic settings, ideally with minimal researcher interference (Flyvbjerg, 2006). Case studies are particularly valuable for examining dynamic social interactions and developments, especially in complex environments where people and technologies intersect. This makes the method well-suited for exploring how students engage with and utilise chatbots, as it accommodates multiple data collection strategies and supports methodological triangulation. Yin (2013) offers a systematic framework for conducting case study research, covering design phases, data gathering, analysis and reporting. Nonetheless, not all information gathered may be in written form and the interpretation of findings often relies on professional judgement and contextual awareness. The resulting case narratives serve as empirical documentation, usually structured around key themes or central narratives that guide the analysis (Yin, 2013).The resulting case

narratives serve as empirical documentation, usually structured around key themes or central narratives that guide the analysis Yin (2013).

Case Description

To investigate the research question, the following course was used as a case.

Didactic Design

The course was delivered in person over seven full days, spaced a week apart, to a diverse group of adult learners engaged in Vocational Education and Training. Participants brought a broad spectrum of educational backgrounds and professional experience, ranging from those without prior AI exposure to seasoned IT professionals. This heterogeneity called for a flexible and inclusive didactic approach, capable of addressing learners' starting points while enabling shared exploration (Hiim & Hippe, 2015; Merrill, 2015).

The teaching design was grounded in the principles of reflective practice-based learning, particularly Fundamental Principle No. 3: Exploration and Fundamental Principle No. 4: The Good Example *(White Paper on Reflective Practice-Based Learning*, 2020)2020. The pedagogical intention was to create a learning environment where the learners could engage with complexity through reasoning, experimenting, hypothesising and critically reflecting on AI outputs and their applications to real-world contexts. This design acknowledged that meaning-making often emerges when prior knowledge is challenged or disrupted, or 'a breakdown of meaning' (Weick & Weick, 1995), and also following chunking of the new insights with the existing knowledge (Oakley, 2014). In this course, such breakdowns frequently occurred when AI responses didn't meet learner expectations and caused a cognitive conflict, prompting deeper inquiry into how generative systems work and how outputs should be interpreted, questioned or refined. The lecturer played an active facilitative role throughout this process. When confusion arose, instructors supported learners by explaining and guiding them to explore why an AI system might respond in specific ways (Shanto et al., 2025). Learners critically evaluated AI outputs, integrating new information with existing knowledge using realistic professional examples as anchors for reflection (inspired by Plan-Do-Study-Act and RPL Principle 4). Generative AI tools like ChatGPT were explicitly taught, focusing on strategic knowl-

edge gathering and treating AI as a critical thinking partner. Collaborative learning occurred in small, stable groups, fostering inquiry and peer feedback, with cross-team knowledge sharing. The approach balanced structured tasks with open, AI-assisted personal inquiry for a reflective, exploratory experience.

Purpose

The course primarily aimed to equip adult learners with practical skills and technological literacy to integrate generative AI into their professional work. Emphasis was on hands-on application using their own use cases for immediate relevance, positioning knowledge as foundational for applied competence (experimenting, evaluating outputs, prototyping). A key secondary goal was fostering a reflective mindset questioning AI, triangulating information to enable responsible and meaningful AI use in complex settings. The course implicitly aimed for workplace skill transfer, hoping learners would become AI catalysts, and supported autonomous learning by encouraging AI use with unfamiliar knowledge. Learner motivation aligned with this application-focused approach.

Activity

Learning activities emphasised situated, hands-on exploration, applying generative AI to real-world professional challenges. The central task was developing an AI proof-of-concept prototype for their workplace. An iterative, PDSA-inspired process encouraged critical reflection on AI outputs, using unexpected results as learning opportunities ('How to check?', 'How to integrate?'). Prompt engineering was taught as a core literacy for effective AI interaction. Learners used ChatGPT-4o by uploading both provided and self-selected materials, iteratively refining prepared prompt templates for translation, summarisation and analysis. For RAG (retrieval augmented generation) workflows, they worked in Langflow, using OpenAI's embedding model and a DataStax-provided vector database to query domain-specific documents. Collaboration was key, moving learners from guided experimentation to autonomous innovation. All materials provided were selected to avoid any copyright infringement, ensuring compliance with intellectual property regulations. In parallel, participants were introduced to the principles of responsible content use. Ethical and legal considerations were explicitly addressed during the course, including discussions on General Data Protection Regulation compliance, data

privacy and responsible handling of personal information. Learners also explored issues such as copyright, intellectual property rights and the ethical implications of AI-generated content, including deepfakes and potential misuse in professional contexts. This exploration was performed in both casework and discussion. These elements were integrated into reflective activities to ensure that participants developed both technical competence and an awareness of the broader societal responsibilities.

Data Collection

This study draws on a combination of qualitative and quantitative data and empirical insights generated through the researchers' dual role as lecturers and observers during the course. By collecting data at multiple stages and from numerous sources, the design enables a triangulated understanding of learner engagement, technological literacy development and the practical integration of generative AI into professional practice. Furthermore, the evaluation followed the Kirkpatrick Framework, stating that the course satisfaction, the learning outcome, the application of learning after the course and the results within the enterprise should be examined to deem a course or another upskilling activity a success (Kaufman, 1996).

Questionnaire on Engagement with Academic Literature

On the first day of the course, participants (n=8) completed an anonymous questionnaire to assess their perceived challenges when engaging with scientific and complex English-language literature. The questionnaire consisted mainly of closed-ended questions, supplemented by a single open text field for elaboration. The purpose was to better understand learners' starting points concerning reading and applying academic knowledge.

Thematic categories included:

- Confidence and reading comfort concerning academic or technical English.
- Sources of difficulty, such as language barriers, unfamiliar terminology or complexity of content.
- Impact of linguistic barriers on motivation and ability to apply knowledge.

- Current strategies used to make sense of complex or unfamiliar texts.
- Perceived importance of accessible academic literature for learning and professional development.

Midway Evaluation of Learners' Own Perceived Knowledge Gain

At approximately the midpoint of the course (session 4 of 7), a short-written evaluation was conducted to assess learners' self-perceived development concerning course objectives. The purpose of the evaluation was both formative and diagnostic, allowing the lecturers to adjust the learning trajectory and gain early insight into how participants experienced their learning progress.

Formal Examination

Three weeks after the final course session, learners completed a formal examination consisting of an individual presentation of their AI prototype. The examination assessed how learners had translated their knowledge and skills into a working proof-of-concept relevant to their practice. This material serves as both a validation of learning outcomes and a data point for understanding how learners integrated AI into their professional thinking and application.

Final Course Evaluation

After the course, participants completed a formal evaluation of the overall course experience. This included both structured satisfaction ratings and opportunities for open feedback. Although not central to the study's primary research question, this data provides valuable context for understanding the learners' perceived value of the course, including how the didactic design and AI tools supported their engagement and learning.

Semi-structured Interviews

Three months after the course ended, follow-up interviews were conducted with three participants who signed up voluntarily. The interviews were designed to explore how learners had applied generative AI in their professional settings and how the tools had influenced their thinking or reflective practice. An interview guide was developed for this purpose, inspired by Kirkpatrick's evaluation framework, focusing on transfer and

behaviour. Each interview lasted 10–15 minutes and was recorded for transcription and subsequent thematic analysis. No participants were preselected based on background or experience.

Empirical Knowledge

The interviews were conducted by the research team, who also lectured during the course. Hence, the study includes an additional layer of empirical documentation, drawn from the researchers' observations and interactions during the sessions. This role required reflexivity to balance facilitation with data collection. All participants provided informed consent, and all data were collected, stored and used following ethical guidelines.

Analysis

To analyse the qualitative data, this study applied the Gioia Method, an approach to develop grounded theory based on empirical observations (Gioia et al., 2013). The Gioia Method offers a structured process for identifying patterns and building conceptual insight from qualitative data, especially interview transcripts. In this study, the process unfolded as follows:

In the initial stage, open coding was used to identify recurring concepts, expressions and themes across the semi-structured interviews. These first-order codes were closely tied to the participants' language and experiences, particularly concerning their use of generative AI, reflections on trust and accuracy, learning challenges and perceived impact on their professional practice.

In the second stage, the first-order codes were grouped and organised into second-order themes, representing the mechanisms through which learners engaged in reflective practice and integrated AI into their work. These themes were also related to technological literacy, critical engagement and cross-domain knowledge transfer. Particular attention was paid to how these mechanisms corresponded to the dimensions of Kirkpatrick's model and RPL concepts.

In the final stage, the axial themes were synthesised into a higher-order conceptual framework, connecting the learner narratives to broader theoretical perspectives on reflective learning, AI-supported knowledge scaffolding and absorptive capacity. This synthesis was used to generate insights about how generative AI can support adult learners in overcom-

ing barriers to engaging with scientific knowledge, such as 'foreign language'.

Results and Discussion

All learners finished the course and participated in pre-, mid-term and final evaluations. They expressed satisfaction with the course topic and design. No students failed the exam: The first two Kirkpatrick levels persisted.

On the first day, participants (n = 8) completed an anonymous questionnaire to assess their perceived challenges when engaging with scientific and complex English-language literature. The questionnaire consisted primarily of closed-ended questions, supported by open text fields to elaborate on specific experiences. The aim was to capture learners' baseline confidence levels, perceived barriers and strategies for academic content.

Reading Comfort and Comprehension Challenges

The responses reveal that half of the participants reported feeling uncomfortable when reading English-language scientific or complex texts. Three participants described themselves as comfortable or very comfortable. One remained neutral. Open responses indicated that complexity of the literature, specialised terminology and difficulty in understanding technical vocabulary were frequent sources of frustration. One explicitly noted:

> *'I quickly lose the overview if the topic is unfamiliar or if the text mixes languages, which often happens.'*

Motivational Impact of Language Barriers

Although three participants reported that language barriers did not affect their motivation, the remaining five identified clear negative impacts. These ranged from decreased willingness to engage with unfamiliar material to increased cognitive load and avoidance behaviour. One participant wrote:

> *'It takes more energy, and I know there will be parts I don't understand.'*

Another noted how using tools like Google Translate is often ineffective when content becomes too technical.

Strategies for Understanding Complex Concepts

When asked about current strategies used to handle complex or unfamiliar terms in English-language texts, the most frequently mentioned tool was online translation services (used by 50% of respondents). A smaller number reported using dictionaries (13%), while none indicated they discuss the material with others. Notably, three participants selected 'Other', and described ad-hoc methods, such as rereading sections or relying on prior knowledge. This suggests a lack of collaborative or structured strategies for dealing with complex literature.

Perceived Importance of Accessible Literature

Significantly, seven out of the eight respondents believed that access to understandable academic texts significantly influences their learning process and professional development. Half (four out of eight) indicated that it impacts their growth to a very high degree, while two reported a moderate impact and only one participant felt neutral. No one selected 'not at all'. These findings underscore the relevance of designing learning environments that scaffold access to complex information, especially regarding academic or research-based knowledge. The data also supports the course's emphasis on using generative AI as a practical, explorative tool to bridge language and domain-related barriers in reading comprehension.

Data Analysis

The Gioia analysis revealed four interconnected dimensions that shed light on how generative AI was used as a scaffold within the learning environment. These are shown in figure 1. The first-order concepts build on statements from the data, and are collated to second-order themes, and again aggregated to dimensions.

AI as a Cognitive Scaffold

Across all three interviews, learners described how generative AI supported their ability to access, comprehend and apply knowledge they would otherwise have struggled to engage with. Participants reported using AI to simplify complex or technical texts, extract key information and generate summaries tailored to their context and level of understanding. One respondent emphasised how AI allowed him to interact with research articles at multiple levels of depth and in different formats, while another highlighted how she now used AI to process dense internal documents far more efficiently than before. These findings suggest that AI reduced cognitive barriers in relation to academic literature or unfamiliar domains and functioned as a tool for contextual adaptation.

Reflective Learning and Knowledge Exploration

A second dimension captured the ways learners used AI to receive information, and to engage in reflective inquiry. Participants experimented with prompting strategies, adjusted outputs based on audience and purpose, and developed workflows. One respondent described how she created and refined her prompt templates, which she used in job search and professional communications. Respondents also discussed how AI enabled them to engage with new domains (e.g. programming or visual modelling) that previously felt out of reach. Importantly, participants also demonstrated awareness of AI's limitations and expressed the need to evaluate the credibility and usefulness of its output, especially in professional contexts. This reflection was often grounded in their domain knowledge, supporting the idea that technological and domain literacy mutually reinforced one another.

Application and Integration in Professional Practice

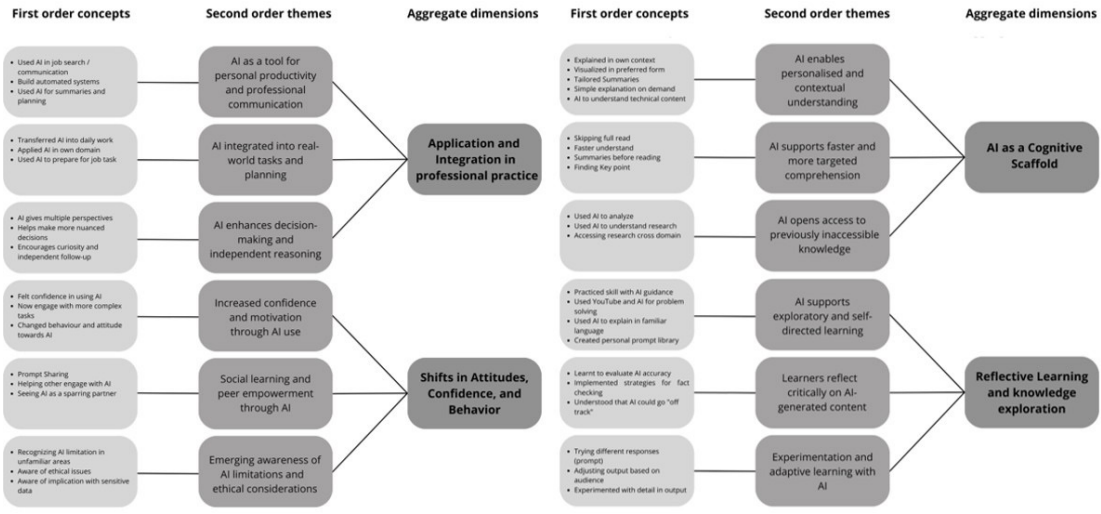
Learners did not treat AI as a theoretical tool but integrated it into concrete professional activities. Examples included using AI to write job applications, summarise policy documents, prepare meeting notes and analyse legislative constraints. One respondent even used AI to automate basic workflow processes, such as transcription and compliance checks. This dimension illustrates how learners moved beyond curiosity and incorporated AI meaningfully into their daily tasks. AI's perceived value increased when it was seen to accelerate tasks and enhance the quality of decisions and communication. In this way, learners actively bridged

the gap between knowledge and action between academic or abstract content and practical, situated application.

Shifts in Attitudes, Confidence and Behaviour

Finally, the analysis revealed important affective and behavioural shifts. All participants described growing confidence, motivation and curiosity as they engaged with AI. For one of the respondents, AI enabled her to explore new topics she would previously have avoided, such as research on migraine, technical fabrics or visual diagramming tools. Another reported feeling increasingly confident in explaining AI to others and encouraging them to use it. Learners reflected on ethical concerns and the boundaries of AI usage, especially in relation to privacy and domain limitations, suggesting the development of a more balanced and critical stance. In several cases, participants began acting as informal AI advocates within their own networks, sharing prompts or advising peers on best practices. These changes suggest that AI use catalysed technical competence and attitude shift.

Figure 1: Results from the Gioia Analysis, with first-order concepts, second-order themes and aggregated dimensions



Discussion

This study highlights how generative AI can function not merely as a technical tool but as a cognitive scaffold that enables adult learners to re-engage with complex scientific literature in meaningful, reflective ways. While learners initially reported low confidence in reading academic text, particularly in English and unfamiliar domains, the integration of generative AI opened new entry points to knowledge that would otherwise have remained inaccessible. In this way, it shows potential to increase the temporal dimension of near transfer, as the new knowledge can be put into perspective swiftly in situations where other dimensions are altered: e.g. the physical context is far from the application area or where the social setting differs (Aarkrog, 2011).

A key insight is that AI did not replace understanding but enabled it. Rather than providing simple answers, AI supported an iterative, exploratory learning process. Participants used AI to simplify, translate and summarise difficult texts, but crucially, they also experimented with prompts, questioned the outputs and adjusted based on context and audience. These behaviours reflect growing technological literacy, not just technical skill. In this sense, AI became both the object of learning and the medium for learning. This dual role aligns with iterative and reflective learning approaches, where knowledge is constructed through questioning, failure and re-framing cycles. Hence, it enables the chunking of ideas and relates them to prior knowledge (Oakley, 2014). The chunking process also takes place when the learner engages in diffuse-mode thinking, not focusing on the task, and how generative AI contributes to this process remains an open question. However, the ability does demonstrate that connections between the prior knowledge of the learner and the new topic are vital to aid later application of new knowledge and later integration into the everyday work-life of the learner (Merrill, 2015). While AI can support and accelerate comprehension, it does not eliminate the need for foundational domain knowledge. Participants themselves emphasised that their ability to critically evaluate AI-generated summaries or translations depended on having at least a basic understanding of the subject matter. They described how they now often skip full readings in favour of AI-generated summaries, which streamlined their workflow, yet they also acknowledged the risks of accepting such outputs at face value. This highlights a potential trade-off where efficiency may come

at the cost of depth and correctness, underscoring the importance of equipping learners with strategies to manage potential AI inaccuracies. Thus, domain expertise and verification strategies remain essential components of responsible AI-supported learning. This concern about efficiency coming at the cost of depth is echoed in emerging research on the cognitive consequences of outsourcing learning processes to a machine. Studies suggest that over-reliance on AI, particularly in the early stages of learning, may lead to 'shallow encoding' of information. When learners outsource the heavy cognitive lifting – such as summarisation and synthesis to an AI, they risk failing to internally integrate the knowledge, which can impair long-term recall, critical thinking and a sense of ownership over their learning (Kosmyna et al., 2025). This highlights a crucial point: generative AI is a powerful tool, but it does not replace the need for foundational domain knowledge, nor can it bypass fundamental learning principles like Vygotsky's zone of proximal development. Learners must still build upon an existing cognitive framework. While AI can act as an effective scaffold to help navigate complex material, it cannot substitute the mental effort required to form durable memory traces. The danger is that the convenience of AI may reduce a learner's inclination to critically evaluate outputs or engage in the deeper, more effortful thinking that is essential for robust understanding. Therefore, pedagogical framing is paramount. To mitigate these risks, educators must position AI not as a shortcut to bypass learning but as a reflective partner that complements and deepens rather than replaces the development of core knowledge and critical inquiry skills.

The interviews further demonstrated how learners integrated AI into professional practice. They moved beyond using AI for individual tasks and began creating workflows, adapting outputs to workplace challenges and even guiding others in AI use. This transfer into an applied context signals that generative AI helped close the gap between theory and practice, between academic knowledge and professional relevance. In some cases, learners began acting as internal drivers of change in their organisations, suggesting that AI use fostered personal development and organisational absorptive capacity. This could be a driving factor for developing absorptive capacity, by enabling social integration and easing knowledge assimilation and transformation within organisations (Lane et al., 2006; Todorova & Durisin, 2007; Zahra & George, 2002).

Significantly, the emotional dimension also shifted: participants described increased confidence, curiosity and willingness to engage with complexity. This suggests that generative AI did not just reduce barriers to access; it increased motivation and agency, enabling learners to take ownership of their learning and apply it more broadly. This targets the trouble that learners with prior negative educational experience feel when enrolled in upskilling, by lowering the language entry barrier to new domains (Decius et al., 2021)we developed a conceptual framework of a ntecedents, p rocesses, and learning o utcomes of IWL among blue-collar workers (APO framework. Similar effects have been seen for other work-easing technologies, e.g. robot implementation, where employees become familiar with the technology, apply it in relevant circumstances and start to appreciate it (Stingl et al., 2024).

This study suggests that when embedded in reflective, practice-oriented learning, generative AI can:

- Lower the threshold for accessing complex, domain-specific knowledge.
- Support experimentation and critical engagement with content.
- Enhance learners' ability to transfer insights into professional action.
- Contribute to longer-term shifts in confidence, motivation and peer learning.

These outcomes point toward a broader role for generative AI in professional education not as a shortcut, but as a catalyst for deeper learning, self-direction and professional adaptation in the face of rapid technological change. Under the right circumstances, it can be used as a reflective artefact by the learner.

The findings of this paper have several limitations. As this paper is positioned within the explorative phase of AI in education, both the data collected and the conclusions drawn could be enhanced by later knowledge acquired in the field. Furthermore, the data were collected from a small sample of students, and they were free to report and exemplify their gains themselves without control of actual implementation. These data were collected partly by the educators, which can also be a point for improvement in later works.

Conclusion

In conclusion, this study answers the research question of whether generative AI can support adult learners in overcoming barriers to scientific literacy within professional education and lifelong learning. By embedding generative AI in a reflective, practice-oriented course design, learners could simplify and interpret complex academic texts and develop strategies for critical engagement. Furthermore, they could also transfer knowledge into real-world contexts, exploiting the knowledge. The findings suggest that generative AI can serve as a scaffold and a catalyst for reflective learning, enabling learners to reframe challenges, test assumptions and construct knowledge through interaction. Generative AI is a technology that might contribute to the overall learning curve. It reduces the barrier to learning new knowledge and applying it in professional education.

Participants reported increased confidence, motivation and independence in navigating unfamiliar domains, demonstrating that generative AI's impact extends beyond technical assistance. It supports learners' broader development as reflective practitioners capable of using AI meaningfully and responsibly in their professional lives. The dual role of generative AI, as both subject and instrument of inquiry, appears to facilitate iterative learning processes and strengthen technological literacy, especially when integrated into structured, exploratory learning environments. As such, generative AI holds significant promise for addressing persistent barriers in lifelong learning and enabling more equitable access to knowledge in technologically evolving professions.

While not the central focus of this study, legal and ethical considerations became increasingly prevalent as participants engaged with AI. Questions surrounding intellectual property rights, data protection under GDPR and the implications of emerging regulations like the EU AI Act surfaced naturally in discussions and reflections. These concerns underscore the need for awareness and competence in navigating the legal landscape of AI use. As AI becomes embedded in professional routines, educational initiatives must not only foster technical literacy but also cultivate ethical sensitivity and regulatory awareness to ensure responsible and compliant use.

This study shows that generative AI can enhance learners' ability to access and apply complex knowledge. While replacing reflection with

generative AI is impossible, the results show that AI interactions support critical thinking, contextual adaptation and professional judgment. The following implications build on these insights and are grounded in the principles of RPL, where generative AI can be used to increase iterative, reflective processes. Hence, educators should position generative AI not merely as an assistant for content delivery but as a reflective partner that supports knowledge exploration and cognitive scaffolding. It remains an open question whether generative AI can act as both simultaneously. Learners interacting with AI through iterative prompt refinement and critical questioning activate deeper thinking processes and engage in hypothesis testing, core to reflective practice and iterative learning. These interactions can lead to conceptual breakthroughs, aligning with the theme of AI as a cognitive scaffold. From an RPL perspective, such moments represent 'suitable disturbances' that open opportunities for insight, theory-practice integration and personal meaning-making.

In this study, learners benefit most when generative AI instruction simultaneously develops their understanding of AI systems and their ability to apply insights critically within their professional domains. This dual development reflects the theme of application and integration in professional practice, where learners move from using AI instrumentally to embedding it in workflows, communication and problem-solving. RPL's emphasis on handling real-world complexity through reflection and action is echoed in scaffolded activities that ask learners to examine AI limitations, test ethical boundaries and validate outputs concerning their specific contexts. These activities reinforce technological and domain literacy and strengthen learners' reflective judgment.

The use of generative AI in education raises important questions about authorship, assessment and ethical responsibility. Educators must build their understanding of legal frameworks such as GDPR, intellectual property rights and the upcoming EU AI Act to guide students in responsible AI use. At the same time, institutions must provide clear policies that define acceptable use, ensure data protection and support staff with professional development. Without such frameworks, responsibility falls unevenly on educators, increasing the risk of non-compliant practices. Institutional clarity is essential for aligning innovation with legal and ethical standards.

Finally, sustainable and meaningful integration of generative AI in professional education begins with educators. While frontrunners among

learners will apply generative AI, the potential of scaffolding must be rooted among educators. The educators must be equipped with technical fluency and pedagogical strategies to create learning environments that foster reflective thinking, collaborative inquiry and responsible experimentation with AI. This is especially important in facilitating shifts in attitudes, confidence and behaviour, which is a key finding in our study. As learners began to see AI as a professional sparring partner, their confidence and curiosity grew. Educators can scaffold this development by embracing their role as facilitators of reflection, in line with RPL's view of teaching as a co-constructed and dialogical learning process.

References

Aarkrog, V. (2011). A taxonomy for teaching transfer skills in the Danish VET system. *Nordic Journal of Vocational Education and Training, 1*(1), 1–13.

Cacicio, S., & Riggs, R. (2023). Bridging Resource Gaps in Adult Education: The Role of Generative AI. *Adult Literacy Education, 5*(3), 80–86.

Decius, J., Schaper, N., & Seifert, A. (2021). Work Characteristics or Workers' Characteristics? An Input-Process-Output Perspective on Informal Workplace Learning of Blue-Collar Workers. *Vocations and Learning, 14*. https://doi.org/10.1007/s12186-021-09265-5

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219–245.

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods, 16*(1), 15–31.

Hiim, H., & Hippe, E. (2015). *Læring gennem oplevelse, forståelse og handling: En studiebog i didaktik* (2. udgave). Gyldendal.

Joshi, S. (2025). Agentic Generative AI and the Future US Workforce: Advancing Innovation and National Competitiveness. *Available at SSRN 5126922*.

Kaufman, R. (1996). What works and what doesn't: Evaluation beyond Kirkpatrick. *Performance and Instruction, 35*(2), 8–12.

Kosmyna, N., Hauptmann, E., Yuan, Y. T., Situ, J., Liao, X.-H., Beresnitzky, A. V., Braunstein, I., & Maes, P. (2025). Your brain on chatgpt: Accumulation of cognitive debt when using an ai assistant for essay writing task. *arXiv Preprint arXiv.*

Laal, M., & Laal, A. (2012). Challenges for lifelong learning. *Procedia-Social and Behavioral Sciences, 47*, 1539–1544.

Lane, P. J., Koka, B. R., & Pathak, S. (2006). The reification of absorptive capacity: A critical review and rejuvenation of the construct. *Academy of Management Review, 31*(4), 833–863.

Lee, D., & Palmer, E. (2025). Prompt engineering in higher education: A systematic review to help inform curricula. *International Journal of Educational Technology in Higher Education, 22*(1), 7.

Li, Z., Wang, C., & Bonk, C. J. (2024). Exploring the Utility of ChatGPT for Self-Directed Online Language Learning. *Online Learning, 28*(3), 157–180.

Merrill, M. D. (2015). A pebble-in-the-pond model for instructional design. *Performance Improvement, 54*(1), 42–48.

Oakley, B. A. (2014). *A mind for numbers: How to excel at math and science (even if you flunked algebra)*. TarcherPerigee.

Oriji, A., & Uzoagu, I. F. (2019). Lifelong learning in a technology-driven society: The needs, the benefits, and the challenges. *European Journal of Education Studies*.

Shanto, S. S., Ahmed, Z., & Jony, A. I. (2025). A proposed framework for achieving higher levels of outcome-based learning using generative AI in education. *Educational Technology Quarterly, 2025*(1), 1–15.

Stiglic, G., Kopitar, L., Gosak, L., Kocbek, P., He, Z., Chakraborty, P., Meyer, P., & Bian, J. (2023). Improving Primary Healthcare Workflow Using Extreme Summarization of Scientific Literature Based on Generative AI. *arXiv Preprint arXiv.*

Stingl, V., Christiansen, L., Hansen, A. K., Lassen, A. H., & Cheng, Y. (2024). Conceptualising the robotisation of manufacturing work: A thematic analysis of the literature using soft systems thinking as lens. *Journal of Manufacturing Technology Management, 35*(4), 799–820.

Storey, V. A., & Wagner, A. (2024). Integrating artificial intelligence (ai) into adult education: Opportunities, challenges, and future directions. *International Journal of Adult Education and Technology (IJAET), 15*(1), 1–15.

Todorova, G., & Durisin, B. (2007). Absorptive Capacity: Valuing a Reconceptualization. *The Academy of Management Review, 32*(3), 774–786.

Weick, K. E., & Weick, K. E. (1995). *Sensemaking in organizations* (Vol. 3). Sage publications Thousand Oaks, CA.

White Paper on Reflective Practice-based Learning. (2020). University College of Northern Denmark.

Yin, R. K. (2013). Validity and generalization in future case study evaluations. *Evaluation, 19*(3), 321–332.

Zahra, S. A., & George, G. (2002). Absorptive Capacity: A Review, Reconceptualization, and Extension. *The Academy of Management Review, 27*(2), 185–203.