

Preparing Educators to Teach and Create With Generative Artificial Intelligence

Préparer les éducateurs à enseigner et à créer avec l'intelligence artificielle générative

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Abstract

Teachers skilled in using generative artificial intelligence (GAI) have advantages in terms of increased productivity and augmented instructional capabilities. Alongside the rapid advancement of GAI, teachers require authentic learning opportunities to build the confidence and expertise necessary for engaging with these technologies creatively and responsibly. This article provides an illustrative case of preparing preservice and in-service teachers with the knowledge, skills, and mindsets to teach and create with GAI. Using a self-study method to investigate professional practices, we analyzed the curriculum, instruction, and assessment in an upper-level undergraduate course in multimedia design and production. Thirty-five teachers engaged in experiential activities focussed on developing artificial intelligence (AI) literacy, alongside a collaborative assignment to co-author an open-access textbook, *Teaching and Creating With Generative Artificial Intelligence*. To support equitable and inclusive access to the educational benefits offered by AI, the Student Artificial Intelligence Literacy (SAIL) framework was developed. SAIL facilitates student AI literacy through curriculum engagement and three distinct types of interactions: cognitive, socio-emotional, and instructor-guided. Building on lessons learned from the COVID-19 pandemic regarding the issues with technology training for teachers in Canada, five recommendations are offered to facilitate the meaningful integration of AI literacy in teacher education programs.

Keywords: AI education, AI literacy, generative AI, instructional design, teacher education

Résumé

Les enseignants qui maîtrisent l'intelligence artificielle générative (IAG) voient leur productivité et leurs capacités d'enseignement augmenter. En cette période d'évolution rapide de l'IAG, il est nécessaire d'offrir aux enseignants de réelles possibilités d'apprentissage en ce sens afin qu'ils acquièrent la confiance et l'expertise nécessaires à l'utilisation créative et réfléchie de ces technologies. Cet article présente un cas de figure illustrant l'acquisition par des enseignants en formation initiale et en poste de connaissances, de compétences et de l'état d'esprit nécessaires pour enseigner et créer à partir des outils d'intelligence artificielle. Nous avons analysé le programme ainsi que le type d'enseignement et d'évaluation d'un cours de premier cycle en conception et production multimédia, avec l'objectif d'étudier les pratiques professionnelles à partir d'une méthode d'auto-évaluation. Trente-cinq enseignants ont participé à des activités d'apprentissage par l'expérience axées sur le développement d'une culture de l'intelligence artificielle (IA), parallèlement à une collaboration en vue de la rédaction d'un manuel en libre accès, intitulé *Teaching and Creating With Generative Artificial Intelligence* (Enseigner et créer avec l'intelligence artificielle générative). Le cadre SAIL (*Student Artificial Intelligence Literacy*) a été créé pour favoriser un accès équitable et inclusif aux avantages éducatifs offerts par l'IA. SAIL facilite l'apprentissage de l'intelligence artificielle grâce à une implication dans le programme d'études et à trois types d'interactions distinctes : cognitive, socioémotionnelle et guidée par l'enseignant. À partir des leçons tirées de la pandémie de COVID-19 concernant les problèmes de formation à la technologie des enseignants au Canada, cinq recommandations sont proposées pour faciliter l'intégration réelle de la connaissance de l'IA dans les programmes de formation des enseignants.

Mots-clés: éducation à l'IA, littératie en IA, IA générative, conception pédagogique, formation des enseignants

Introduction

The field of education has been disrupted by powerful artificial intelligence (AI) technologies with user-friendly interfaces that can see, hear, speak, and help in real time, allowing for more natural human-computer interaction (Bauschard, 2024). Today's AI learning companions are being developed with emotional quotient, intelligence quotient, and adaptability or adversity quotient. The research goal of companies training AI systems is artificial general intelligence, meaning a machine can do any task better than a human and “can self-teach and solve problems it was never trained for” (Amazon Web Services, n.d., para. 4). At a time of rapid and radical technological change in our world, education is more important than ever. Teachers need to be equipped with AI literacy skills and knowledge to foster learning environments where generative artificial intelligence (GAI) is used to enhance learning outcomes, promote equity, personalize learning, and prepare students to live and work in a world of advanced AI.

This article introduces the Student AI Literacy (SAIL) framework, which we developed through an iterative process of professional reflective inquiry with the goal of supporting teachers to use GAI creatively and responsibly. Members of the teacher education community were invited to critique the

SAIL framework and “begin to use, build on, develop, adapt, adjust, and innovate the work in ways meaningful to their own teaching and learning context” (Loughran, 2005, p. 14). Next, we reflect on how we facilitated a constructivist learning environment in which students were invited to co-author an open-access textbook, *Teaching and Creating With Generative Artificial Intelligence* (ETAD 402, 2023). This assignment aimed to empower preservice and in-service teachers to critically evaluate how GAI can support or harm learning in formal educational settings. We discuss the implications for facilitating AI literacy amongst educators, building on the issues in the literature and analyzing what the COVID-19 pandemic revealed about teachers’ technology training and their challenges in using technology effectively. Through collaborative reflective practice (Bullock & Butler, 2022), we apply the insights from our inquiry to contribute five targeted recommendations for integrating AI literacy across teacher education curricula.

Literature Review

Artificial intelligence technologies have transformed how people learn, create, connect, and work in our world (Ciampa et al., 2023; MacDowell & Korchinski, 2023; Zhang & Aslan, 2021). While AI has been traditionally associated with computer science and technical disciplines (Casal-Otero et al., 2023), the extensive reach of GAI throughout society necessitates its integration into teacher education curricula (Bauschard, 2023; Celik et al., 2022; Nazaretsky et al., 2022). Preservice and in-service teachers must develop critical AI literacy skills to serve as role models for responsible use and prepare future student generations to become “effective users, informed questioners, and reflective producers” (Johnson, 2023, p. 172). Long and Magerko (2020) defined AI literacy as “a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace” (p. 2). Their definition highlights the essential skills and competencies needed to thrive in a world increasingly influenced by AI.

Future educators will benefit from GAI’s assistance in finding diverse instructional solutions for varying learning needs within the classroom. While teachers need not be GAI experts, they must possess appropriate competencies and confidence to integrate technology in ways that are responsible and innovative (Cope et al., 2020; Kaplan-Rakowski et al., 2023; Kim et al., 2022). Using prompting techniques, teachers can generate personalized learning materials to differentiate instruction, including supplementary readings, study guides, flashcards and worksheets, interactive media, illustrative images and artwork, and simulations and games to enrich the learning experience (MacDowell & Korchinski, 2023). However, simply focusing on the basic or practical uses of AI education is insufficient. Teacher education programs must extend training beyond the application of GAI to foster a deep understanding of the technology: how it works, who made it, who profits, and how it will affect daily life and society (Bauschard, 2023; Long & Magerko, 2020; Park, 2023). For example, the ROBOT evaluation tool by Hervieux and Wheatley (2020) is a helpful aid in guiding students to consider AI education in terms of its reliability, objective, bias, ownership, and type (ROBOT).

The AI literacy competencies of teacher training programs should not be assumed, as the ability to use technology does not equate to AI literacy practices (Hagerman et al., 2020; Johnson, 2023; Prachagool et al., 2022). Teachers must engage in critical dialogues and experiential lessons to gain the

knowledge required for integrating technologies to enhance learning; however, concerns about their unpreparedness for using GAI are widely acknowledged (Celik et al., 2022; Kaplan-Rakowski et al., 2023). Zhao et al. (2022) drew attention to teachers' lack of AI literacy and called on governments to increase professional development and design training that values educator agency and expertise as "motivation and attitude towards AI is one of the important factors influencing AI literacy" (p. 11). Park (2023) argued that teacher training programs need to provide the "practical experience of integrating acquired artificial intelligence into classes rather than simply learning AI literacy knowledge" so educators can develop confidence and self-efficacy (p. 2). Furthermore, we call attention to Johnson's (2023) argument that "policing is not pedagogy" (p. 172) and agree that strict surveillance or punishment to avoid the dishonest use of chatbots are insufficient measures to foster genuine understanding and responsible use of GAI.

As a disruptive technology, GAI has had a polarizing effect on the educational community, with attitudes ranging from unwarranted confidence and excessive use to outright resistance and suspicion (e.g., Akgun & Greenhow, 2022; Celik et al., 2022; Cope et al., 2020; Kim et al., 2022; Zhang & Aslan, 2021). Dispositions of mistrust and opposition tend to divert attention towards enforcing rules and discipline, overshadowing the more human aspects of education, such as nurturing relationships, curiosity, imagination, and joyful learning (Casal-Otero et al., 2023; MacDowell & Korchinski, 2023). University courses that educate about the benefits of GAI—such as enhanced creativity, increased productivity, and augmented capabilities—play a pivotal role in preparing teachers for future classroom scenarios that will benefit from innovative applications of AI education (Bauschard, 2023; Nazaretsky et al., 2022; Zhou et al., 2022). Teacher education programs should nurture critical mindsets, considering how cultural and ethical dimensions are inseparable from technological development. As Johnson (2023) argued, "Technologies do not exist in isolation from cultural practices but rather reflect and reify the practices and ethics of the designer(s)" (p. 170). By encouraging educators to contribute to the design and evaluation of AI-enhanced instruction, we can empower them to shape their professional identities as leaders in AI literacy, extending their influence within the classroom and beyond (Celik et al., 2022; Park, 2023).

Research Design and Methods

A collaborative self-study method was employed to examine professional practices, drawing inspiration from the methodological work of Bullock and Butler in *Learning Through Collaboration in Self-Study* (2022). The aim was to deepen understanding and articulate our approach to preparing educators to teach and create with GAI. Building on the rationale of Lock et al. (2020), collaborative self-study was selected as a suitable research method to "share and illustrate examples of our professional practice" (p. 7) in a way that is meaningful and applicable to other teacher educators. We offer an illustrative case focused on the instructional design of an online course, Multimedia Design and Production (ETAD 402), making our practice transparent, analyzing the tensions and challenges that emerged, and providing recommendations based on our pedagogical experiences. Acknowledging the limitations of collaborative self-study, including the potential for bias and the subjective nature of self-reporting our practices as teacher educators (Vanassche & Kelchtermans, 2015), we thoughtfully include

teacher perspectives of their learning in ETAD 402 to enhance our case's credibility, trustworthiness, and applicability.

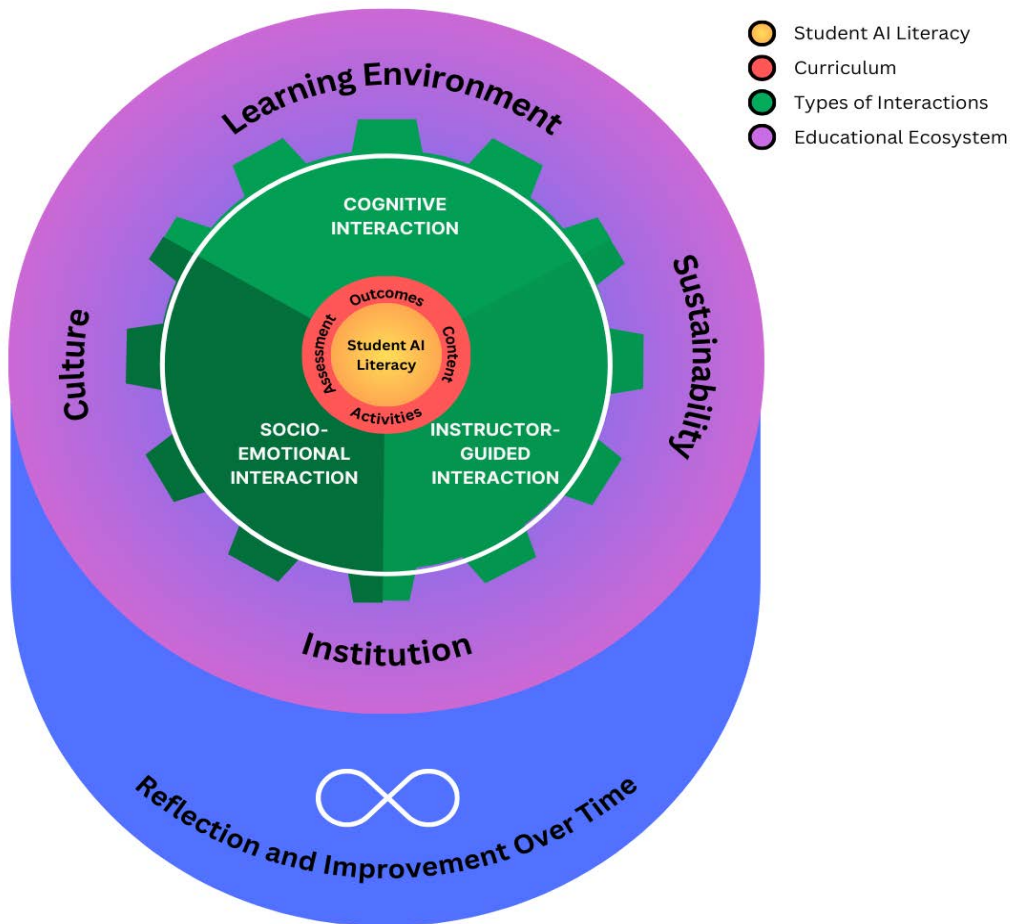
Teachers included 27 preservice and 8 in-service teachers enrolled in an elective three-credit multimedia design course over 13 weeks during the fall term of 2023. The teachers had various areas of expertise, including early childhood, primary, and secondary, and resided in British Columbia, Alberta, and Saskatchewan. The course was delivered online through the Canvas platform, offering asynchronous learning complemented by live Zoom sessions for deeper discussions and support. Teachers were invited to reflect on their learning experiences in the course by completing an open-ended survey designed to gather authentic feedback (Appendix). The survey responses ($n = 35$) were analyzed to understand the teachers' perceptions of what and how they learned about GAI. These findings helped identify areas for enhancement in our course content and teaching methods. Our inquiry was guided by two questions: How do we prepare teachers to use GAI creatively and responsibly? How can a constructivist online learning environment contribute to developing AI literacy among educators?

Student AI Literacy Framework

In the development of ETAD 402, the primary focus was on establishing clear and relevant learning outcomes to equip preservice and in-service teachers with the necessary skills and insights to navigate AI education. The following four learning outcomes served as guiding pillars while creating the course curriculum:

- *Demonstrate proficiency in AI literacy:* Develop the ability to critically evaluate how GAI can support or harm learning in formal educational settings.
- *Design inclusive learning environments:* Understand how to design, select, implement, and evaluate educational media to achieve specific learning objectives.
- *Apply instructional design principles:* Acquire the skills and knowledge to create multimedia learning resources for an educational setting that is meaningful to you.
- *Communicate persuasively:* Reflect upon and articulate your philosophy of technology-enhanced instruction, drawing from the course concepts and personal experiences.

During team meetings to plan ETAD 402, it became evident that a framework was needed to guide us in preparing teachers to use GAI creatively and responsibly. After searching the educational literature, we were inspired by the Student-AI Collaboration (SAC) model by Kim et al. (2022), as it resonated with our vision to integrate GAI as a learning partner. Using an iterative design process, we developed the SAIL framework (Figure 1). SAIL embodies a holistic approach to facilitating student AI literacy by integrating it into the curriculum, fostering meaningful interactions, and embedding it within the educational ecosystem. Guided by the SAC model, the SAIL framework was purposefully designed to be intuitive and user-friendly for teachers. Unlike SAC, which emphasizes the curriculum as its core, SAIL centres around student AI literacy. The acronym SAIL serves as an abbreviation for the framework and a metaphor for a voyage of discovery learning with GAI.

Figure 1*Student AI Literacy Framework*

Note. Figure developed by the authors.

Types of Interactions in the SAIL Framework

Guided by the SAIL framework, ETAD 402 aimed to scaffold the curricular activities and assessments to align with course learning outcomes and three different types of interactions: cognitive, instructor-guided, and socio-emotional (Figure 2). During the course, preservice and in-service teachers were challenged with a range of cognitive interactions (e.g., ungraded design activities promoting intellectual curiosity and inquiry) and graded assignments requiring deeper independent investigation of the ideas introduced in the design activities. Instructor-guided interactions included providing formative feedback on all assignment drafts before the final version due date, thereby challenging understanding without the pressure of formal assessment. Discussion boards and peer reviews were used to support socio-emotional interactions, providing a social space for authentic conversations and opportunities for professional growth and participation. We received abundant feedback from teachers expressing how much they valued the online socio-emotional interactions: “By speaking with people in the class, the concept of AI became much more humanized and authentic” and “I found all peer interactions to be

uplifting, respectful, and useful in continuing my education with technological design.” Another teacher articulated the impact of peer interactions:

What has struck me first and foremost in reflecting on this course is how important it was to have ongoing communication with my peers to learn authentically. Exploring the different tools and tricks of AI was not only much more in-depth, but simply easier with other people alongside me in the exploration. We all started out not knowing much about how to use AI in the classroom, and we learned through each other and in connection with each other.

Figure 2

Types of Interactions Aligned with Activities and Assessment

Reflection and Improvement Over Time			
Interactions		Activities	Assessment
Student AI Learning	Cognitive Interaction	<ul style="list-style-type: none"> • Explore course modules and scholarly readings • Test AI applications and analyze the affordances and constraints 	<ul style="list-style-type: none"> • Author AI book chapter • Design AI how-to demo • Midterm reflections • A personal statement acknowledging use of AI
	Socio-Emotional Interaction	<ul style="list-style-type: none"> • Debate with ChatGPT • Design a personalized chatbot • Critical conversations in small group discussions 	<ul style="list-style-type: none"> • Peer reviews of other students’ drafts before the final due date • Synthesis of participation and professionalism
	Instructor-Guided Interaction	<ul style="list-style-type: none"> • Leading microlearning activities during team Zoom meetings • Guiding the creation of an open-access textbook 	<ul style="list-style-type: none"> • Formative feedback on assignment drafts • Summative feedback on assignments and design presentations

Note. Figure developed by the authors.

Educational Ecosystem

Within the SAIL educational ecosystem, the primary instructional challenge was facilitating a learning environment that provided a sense of safety, inspiration, and support. We wanted teachers to build confidence in experimenting with GAI without feeling overwhelmed. Hence, we developed low-stakes activities, provided mentorship and formative feedback throughout the course, and offered innovative assignments geared towards developing AI literacy. The constructivist learning environment played an essential role, fostering a culture characterized by values of collaborative and empowered

learning through meaningful connections with peers and chatbots. We acknowledge institutional support for the course redesign, including allocating funds for two research assistants. The collaboration pipeline extended beyond ETAD 402, encompassing the co-creation of an open-access textbook, and extending to guidance from colleagues and benefiting from administrative support. A commitment to reflection and continuous improvement over time underscores our instructional design approach, which aligns with GAI's rapid advancement. We recognize that educational ecosystems must evolve and respond to cultural and technological shifts to remain relevant and support students to the best of our capabilities. Capturing the value of adapting to change, one teacher reflected:

I initially only took this class as an extra credit, but I now realize how grateful I am to have been given the opportunity to learn from this course. I believe this may be one of the most important, thought-provoking classes I have ever taken. I learned about a changing culture, one built around new forms of technology that will inevitably have an impact on my life and the lives of my students. I learned how to adapt to this new change, ensuring that my students are taught using modern means, but also in a way that is ethical and professional. Above all, I learned the importance of embracing change, allowing students the opportunity to learn with newer resources.

Preparing Educators to Teach and Create with GAI

The instructional design in ETAD 402 is grounded in constructivist principles whereby knowledge is actively constructed by learners interacting with the course materials, ideas, technologies, and diverse perspectives—and further developed by reflecting on their learning experiences and validating new understandings through dialogue with peers (Ertmer & Newby, 2013). We nurtured an inclusive learning environment where teachers were valued and encouraged to take risks while engaging with the course resources (e.g., readings, videos, and modules equipping them with foundational knowledge) and completing weekly activities and assignments focussed on AI education. As Vaughan and Lee Wah (2020) found in their research on developing preservice teachers' capacity for shared metacognition, our approach goes beyond individualistic learning by incorporating “self- and co-regulation that integrates individual and shared regulation” (p. 1). We aimed to build upon teachers' previous knowledge while fostering new understanding to emerge through collaborative learning experiences. Uniquely, the shared metacognition in ETAD 402 included the teachers' interactions with each other and chatbots.

Like Hollister et al. (2022), we recognize that social interaction with peers and authentic connection with instructors can enhance learning in an online course. Hence, we designed opportunities for social engagement through team design activities and peer reviews, encouraging the teachers to make critical friends and receive feedback to improve their coursework. We also set up asynchronous discussion forums to promote critical dialogue and questioning of AI education concepts drawn from the course readings and videos. To facilitate an effective discussion environment, teachers were grouped into smaller clusters of seven, ensuring a manageable volume of posts to read and write. During live synchronous meetings, teachers were asked to connect theoretical insights with real-world teaching contexts. Questions such as “How does student interaction with GAI impact traditional understanding of

learning and assessment?” and “What are instructional design considerations as students interact more naturally with chatbots?” were posed to stimulate reflection and application of the course concepts.

Another key component in ETAD 402 was scaffolding learning through hands-on experiences, offering teachers relevant opportunities to develop a deep and critical understanding of AI education. Each learning activity integrated previous knowledge to facilitate meaningful learning over time and not overwhelm the teachers who began the course without much experience or confidence in using GAI. We started the course by exploring some of the thousands of GAI applications and discussed how teachers who learn to use them effectively have advantages over their peers (e.g., reduced workload and enhanced instructional capabilities). This group exploration led to each teacher choosing one GAI application to research for a book chapter assignment, which involved several drafts and getting feedback from peers, instructors, and chatbots. A concise description of scaffolded learning opportunities in ETAD 402 follows, including weekly practice activities (e.g., designing a personalized chatbot and debating with ChatGPT) and the major course assignment to co-author an open-access textbook.

Weekly Practice Activities

The teachers were invited to design a personalized chatbot, including configuring the initial greeting, setting the level of creativity and predictability in how the chatbot answers, and introducing a unique prompt as the directive. This activity was designed for teachers to gain first-hand experiences with customizing GAI for personalized learning and to develop confidence and proficiency in using new technologies. The approach aligns with Zhao et al. (2022) who found that teachers need AI literacy training that is “diverse rather than conformist, as this may result in teachers’ agency not being valued” (p. 11). Following the creation phase, they had an opportunity to test each other’s chatbots. This resulted in a meaningful class discussion on the ethical considerations, including how easy it can be to manipulate people through convincing chatbots that are programmed to provide false or misleading information.

One notable course update was transforming a traditional weekly discussion forum into a debate with ChatGPT. This activity was designed to discern how teachers demonstrate empathy and relate to an AI chatbot. Additionally, the teachers learned how to cite their ChatGPT debate using the correct APA format, reinforcing scholarly practices in AI-assisted conversations (Sullivan et al., 2023). First, a detailed prompt was provided for the teachers to input into ChatGPT, which trained it to offer counter arguments and thought-provoking questions in response to the teachers’ arguments. Next, the collaborative aspect of this activity invited the teachers to post links to their debates in the Canvas discussion forum. The teachers were not required to use ChatGPT; they had the option of learning by reading and commenting on their peers’ debates, thereby fostering a dynamic exchange of reflections and critical perspectives. As Kaplan-Rakowski et al. (2023) discussed, providing inclusive options for the weekly assignments is necessary as some teachers may have privacy concerns or other issues with AI chatbots.

The effectiveness of the weekly practice activities in ETAD 402 is evident by its transformative impact, offering teachers forward-thinking opportunities to develop practical skills using GAI

multimedia design. Feedback collected was positive, with teachers expressing gratitude statements such as: “Feeling more comfortable with AI has been worth its weight in gold to me” and “This course taught me a lot about generative AI tools, the ethics surrounding them, and the importance of thinking critically about the tools we use.” Many teachers commented on the relevance of the course content and how it challenged them: “Due to the format and required components of this course, I have grown as a teacher Although at times stressful, this has been the most rewarding course I have taken in this program.” Another common theme reflected was their initial fear and uncertainty at the beginning of the course, as illustrated in this example:

I had been nervous about coming into this course and in complete honesty, still felt nervous in the thick of it; there are so many opinions about AI in general, but AI in the classroom is a complex concept even more so. However, this course helped me feel comfortable with the changes to come and to deconstruct many of my previous beliefs about technology in the classroom; I now look forward to teaching with AI!

Major Course Assignment: Co-Authoring an Open-Access Textbook

To make an academic writing assignment more meaningful and impactful, each teacher was challenged to contribute a short book chapter to an open-access textbook titled *Teaching and Creating With Generative AI* (ETAD 402, 2023). Amongst the 35 chapters, the teachers explored a diverse selection of low- or no-cost GAI applications designed to enhance teaching and learning, including NoleJ (microlearning), Breathing AI (wellbeing), AIVA (music education), Gliglish (language learning), Eduaide AI (differentiated instruction), Lumen5 (video creator), and Gamma (presentation creator). A feature of the textbook is that every chapter offers step-by-step instructions, accompanied by screenshots and video demonstrations, showing readers how to benefit from the featured AI. Another feature is that the chapters offer insights on critical AI literacy with considerations for integration in curriculum and instruction. Uniquely, the chapters begin with a visual introduction through a GAI image, including the application and prompt used. For example, Figure 3 is the image representing chapter 32, generated using the AI tool Imagine Art with the prompt: “wilderness of knowledge, compacted in understanding” (ETAD 402, 2023).

Figure 3

Image Representing Chapter 32 Titled “Expanding your NoleJ” (ETAD 402, 2023)



To facilitate the writing process, a template was provided to guide the teachers in authoring well-balanced chapters that analyzed the affordances, constraints, and tensions associated with AI education (Table 1). We assigned the textbook a Creative Commons Attribution Non-Commercial Share Alike 4.0 International Licence (CC-BY-NC-SA-4.0); however, GAI images are uncopyrightable. Building on Sullivan et al.’s (2023) research into ChatGPT, academic integrity, and student learning, we asked each teacher to be transparent in documenting the role of GAI in their assignments. For example, one author acknowledged:

ChatGPT was used in writing this chapter for the purposes of generating image prompts, as well as assisting with some editing and paragraph structure. Paragraphs were written, re-written, and summarized by the author in his own words. All independent research and citations were conducted by the author. Craiyon AI was used for image generation, as indicated throughout the chapter and presentation. Craiyon AI images were used in combination with Photoshop and image references from Google and Bing for educational purposes. WOMBO Dream AI image generator was used for cover art generation.

Table 1*Guiding Template for the Book Chapters (Abbreviated)*

Chapter part	Guidance
Chapter title	The title is the shortest one-sentence description of your chapter. Make it interesting, unique, descriptive, and concise.
GAI image	Create an image representing your chapter (include the prompt and application).
Introduction	Provide an overview of the chapter's purpose and relevance.
Critical AI literacy	Explain how the GAI tool connects to the curriculum and training context, emphasizing the need for critical AI literacy.
Affordances and constraints	Analyze the GAI's educational potential and provide any limitations or restrictions readers should know.
How-to instructions	Provide instructions or guidance for using the GAI tool.
Prompting	Provide insights on how to generate better results with effective prompting techniques.
Recommendations	Offer recommendations, readings, online communities, or additional resources to enhance the reader's understanding.
Video demonstration	Create a how-to guide demonstrating GAI performing the task.
References	List all references, including the GAI applications and chatbots.
Acknowledgement of GAI use	Include a personal statement describing how you used GAI to enhance your chapter.

Teaching and Creating With Generative AI (ETAD 402, 2023) extends its impact beyond our class. The teachers appreciated the pedagogical value of the co-authored textbook and repeatedly mentioned they felt an immense sense of pride contributing to what they see as a ground-breaking resource for assisting other educators to integrate GAI in their practice. When asked to provide one word describing their chapter, the most frequently mentioned descriptors were “accomplished,” “useful,” “proud,” “satisfied,” and “informative” (Figure 4). Several teachers remarked on their augmented capabilities: “I learned how AI can help me create more inclusive lessons and open up many opportunities for differentiated instruction” and “The biggest thing I have come away with is the significance of modelling positive AI use for my students.” Initially approaching the course with minimal expectation for a genuine learning experience, another teacher expressed a transformative shift in perception:

At the beginning of this course, I only wanted to get the course credits and get out. I had no intentions of getting a real learning experience. I soon found out that I was wrong. I did not think that I would get to explore things like incorporating AI into teaching lessons. I thought that AI

was only something that people used to cheat on assignments, and I never considered that there were ways to positively use these programs.

While the teachers had positive experiences and were grateful for being challenged to learn about GAI, constructive criticism on minor instruction design issues was expressed. Notably, suggestions included allowing more time for mastering their selected GAI application before writing their chapter, providing a weekly checklist of tasks with well-defined directions and due dates, and improving consistency and flow within the open-access textbook for a better reading experience. Pressbooks (<https://pressbooks.com/>) was chosen as it is currently the most user-friendly online software for publishing open educational resources in multiple formats accessible on mobile devices, desktop browsers, and e-readers. However, some educators encountered difficulties formatting their chapter in Pressbooks and highlighted the importance of peer support in overcoming these technical hurdles. Despite enjoying the autonomy and creative freedom in the learning process, a few educators felt overwhelmed by the vast array of GAI tools, suggesting: “The template was helpful for this, but perhaps making the scope of topics available a bit less broad would give students more direction when beginning the project.”

Figure 4

Wordcloud Showing Most Common Teachers’ Responses to the Question: “Give One Word to Describe Your GAI Book Chapter”



Note. Figure developed by the authors.

The teachers unanimously responded that co-authoring a textbook was a useful assignment in an online university class, noting that it allowed them to learn independently and collaborate with peers. Their reasons for recommending this assignment for future classes include: “Designing a textbook together allows for increased collaboration and interaction amongst peers in an online setting and gives everyone in-depth information on a variety of tools that otherwise they would not have been able to explore on their own.” Additionally, “It contains everything that an instructional activity should have. It was fun, it allowed for individual expression, there was a real-world aspect to it, and it involved problem-solving, and higher order thinking skills.” Many teachers appreciated the relevant opportunity to explore, apply, and share their knowledge: “The textbook format leads students to consider how their chapter might be useful to someone that reads the textbook rather than just creating something to hand in for a grade,” and “My mom is a teacher and I plan on sharing the textbook with her because not only can she see some of the work I’ve done in university, but also share in the learning from all my classmates.”

Artificial intelligence literacy growth and development was a recurring theme in the teachers’ reflections. For example, “I increased my own AI literacy, as well as learned how to incorporate this literacy into multimedia educational resources and implement AI into the classroom to further support learning” and “I know AI will always be changing and growing, but I will be changing and growing with it. And I hope that wherever it may go, it will allow me to be the best teacher I can be.” The assignments and reflective discussions allowed for deep and meaningful learning about the ethical dimensions of GAI, voicing concerns, and contemplating proactive measures for teaching and learning. After reflecting on the course outcomes, however, we recognized the need for additional coursework to increase opportunities for teachers to develop their AI literacy skills. Consequently, we are designing a new module including deep fakes, misinformation, and social manipulation (Akgun & Greenhow, 2022; Celik et al., 2022). Our initiative underscores how the ongoing evolution of the course content needs to align with the fast pace of technological advancements in order to provide relevant guidance on the evolving ethical complexities. Responsible use of GAI was articulated by a teacher who reflected on the value of educators as positive role models:

By using AI openly, educators set an example for their students on how to foster a constructive relationship with AI. By allowing students to engage with AI in ethical ways that promote active learning, creativity, and critical thinking, educators are encouraging students to continue engaging with it positively.

Discussion and Implications

Preparing Educators to Teach AI Literacy

Research from the COVID-19 pandemic highlighted a significant issue: teachers were largely unprepared for the sudden shift to remote teaching facilitated by digital technologies. Lacking sufficient knowledge and resources, teachers struggled with adapting to new platforms for delivering a modified curriculum to students in a home environment (Francom et al., 2021). The focus on the emergency use of technologies, coupled with limited guidance from school administration and the realization that some students were more technologically adept, significantly heightened teachers’ stress and anxiety levels

(Prachagool et al., 2022; Robinson et al., 2022). Teachers often found themselves reacting to challenges beyond their control, such as student cheating and disengagement (Hollister et al., 2022). Their unpreparedness highlighted a gap in the technology training provided by teacher education programs across Canada.

Further concerning, the pandemic emphasized the long-standing deficit of digital literacy education within Canadian school curricula, as noted by Hoechsmann and Poyntz (2017). Teachers, parents, and students were unprepared for the increased screen time (e.g., they lacked understanding of how to engage with technology in healthy ways and knowing when to disconnect). Many students engaged in media multitasking, simultaneously using multiple devices or windows for activities such as watching TikTok or YouTube videos and texting friends on Snapchat while completing homework assignments or participating in Zoom classes (Hollister et al., 2022). Students spent extensive time in front of screens, often unsupervised, without the ability to evaluate the quality of the content they viewed and consumed. MediaSmarts (2023) reported deficiencies in digital literacy skills amongst Canadian youth and argued for a “national strategy to prioritize digital media literacy education in classrooms and communities” (p. 5). These findings provoke a critical question: Knowing the gaps in students’ digital literacy skills (both prior to and during the pandemic), have teacher education programs adapted to prepare educators with the necessary skills to teach critical digital literacy? Or has the urgency to address this issue diminished with the pandemic’s decline?

The advent of the post-pandemic era introduced another major technological disruptor in the field of education: GAI, which presents new tensions, affordances, and literacy concerns (Akgun & Greenhow, 2022; Bauschard, 2023; Johnson, 2023). Generative AI offers educators the potential to personalize learning experiences and foster inclusivity by bridging disparities between students of varying cultures and backgrounds (Cope et al., 2020; Zhang & Aslan, 2021). However, without appropriate oversight, GAI could exacerbate issues such as the digital divide, misinformation, privacy violations, and reduced critical thinking due to overreliance on technology (Casal-Otero et al., 2023; Pedró et al., 2019). The effectiveness of any educational technology, GAI included, depends on how it is developed and implemented in classroom learning environments. Therefore, it is vital to equip teachers with “the new literacies of 21st century technologies,” empowering them with AI literacy training to guide the responsible and innovative use of AI and prepare students for “the literacy futures they deserve” (Ciampa et al., 2023, p. 190).

Recommendations for Teacher Education Programs in Canada

We encourage teachers to adopt a dual role as innovators, exploring GAI’s possibilities for enhancing educational experiences, and guardians, understanding and mitigating GAI’s potential risks. Considering the challenges teachers faced during the pandemic, particularly their unpreparedness to adapt to digital technologies, we see an urgent and substantial need for teachers to have continuing professional development and training in AI literacy. To this end, we recommend five strategies to facilitate the meaningful integration of AI literacy in teacher education programs.

Do No Harm With GAI

Promoting responsible use must be a top priority. Teachers need to understand the ethical dimensions associated with AI education. To the overworked educator, GAI's ability to instantly generate content is enticing: written work, lesson plans, assignment feedback, and information gathering take mere minutes instead of hours or days (MacDowell & Korchinski, 2023). Generative AI content, however, can be biased, misleading, and harmful if not carefully analyzed by a human (Park, 2023). Where it is increasingly difficult to distinguish real from manipulated media (e.g., images, text, and video), teachers must learn about GAI misuses and deep fakes that can serve to disseminate misinformation and disinformation (Bauschard, 2023). Teachers must develop critical thinking skills (e.g., evaluating information from chatbots, discerning authenticity, and identifying bias within algorithms) to guide students toward responsible use (Casal-Otero et al., 2023).

Develop Chatbot Communication Skills

Teachers need training on how to communicate and collaborate with AI chatbots (Sullivan et al., 2023). Our research indicates that teachers' confidence and trust in AI education increased after they developed prompting skills and learned how to fine-tune their interactions to maximize the potential of chatbots as helpful teaching aids. Chatbots must be provided with information such as the context, role, tone, detailed instructions, and examples (or non-examples) of the expected output. Without well-crafted prompts, there is a risk of chatbots generating irrelevant or subpar content, leading to skepticism and reluctance among teachers to integrate GAI into their practice. Developing effective communication skills will help teachers mitigate misconceptions and foster understanding that collaborating with chatbots requires a careful balance of fearful respect and responsibility (Celik et al., 2020; Ciampa et al., 2023).

Facilitate Experiential Learning With GAI

Educating teachers about the importance of AI literacy is essential; however, theoretical knowledge without practice is insufficient. Teachers need hands-on opportunities to experiment with various GAI applications and evaluate their applicability for diverse educational settings (Nazaretsky et al., 2022; Zhao et al., 2022). To foster AI literacy, teachers must comprehend and demonstrate responsible and transparent use of GAI (Ciampa et al., 2023). Our research suggests that teachers benefit from assignments that focus their time and attention on experiential learning with GAI while developing theoretical understanding by discussing course readings. Further, it is beneficial to incorporate low-stakes practice activities (e.g., designing a chatbot personality, debating with a chatbot, and generating videos from text). These practice-oriented tasks familiarize teachers with various approaches for integrating GAI in curriculum, instruction, and assessment (MacDowell & Korchinski, 2023).

Infuse AI Literacy Across the Curriculum

Preservice teachers should graduate with the confidence and knowledge of how to leverage GAI to benefit their practice (Park, 2023). In-service teachers who are well-versed in the affordances and constraints of AI education will have the necessary skills to prepare their students to participate in a society where AI is ubiquitous (Kaplan-Rakowski et al., 2023). Our study is limited as it focuses on a

singular, stand-alone course aimed at educating teachers about GAI design, concepts, applications, and ethical considerations. A more effective approach would be integrating AI literacy across all teacher education courses involving pedagogical and content knowledge (Nazaretsky et al., 2022). A shared commitment from researchers, administrators, and key stakeholders in the educational sector will contribute to developing professionals with AI literacy skills and “build a stronger and more flexible foundation for digital literacies teaching and policies in Canadian systems of schooling” (Hagerman et al., 2020, p. 26).

Address Inequalities in AI Education

The United Nations’ fourth Sustainable Development Goal aims to provide and promote inclusive, equitable, and quality education for all, a commitment that extends to powerful learning technologies such as GAI and chatbots (Pedró et al., 2019). Teachers need to understand how the digital divide increases when marginalized communities do not have Internet connectivity, device availability, or equal learning opportunities. This knowledge can help them implement strategies ensuring that all students, irrespective of their socioeconomic or cultural backgrounds, have equitable access to the benefits of AI education (Bauschard, 2023). In our research, teachers collaborated to produce an open-access textbook via Pressbooks, which provided a platform to share their collective experiences, best practices, and design expertise. The co-authored textbook highlights the value of co-creating open educational resources in a university course. By fostering a culture where knowledge and experiences are openly shared, we can work toward bridging the AI literacy gap amongst educators and ensure the benefits of AI education are more evenly distributed (Celik et al., 2022).

Conclusion

In response to the need for practical and actionable frameworks to guide the use of GAI in K-12 and higher education classrooms, our research team designed the SAIL framework. SAIL contributes a holistic approach to integrating AI education, including the dynamic interplay of curriculum, culture, learning environments, sustainability, and institutional support. Teacher-guided interactions in SAIL highlight the importance of human mentorship in preparing students to use GAI creatively and responsibly. We invite researchers, instructional designers, and practitioners to build upon, refine, and evaluate the SAIL framework; the aim is to share the benefits of AI education equally and be proactive to prevent unforeseen harm.

Our open-access textbook, *Teaching and Creating With Generative AI* (ETAD 402, 2023), offers tangible examples of how GAI can foster learning experiences that are experiential, interactive, and adaptive. Through collaborative exploration, the teachers learned how GAI can augment their creativity, productivity, and instructional design skills. The textbook demonstrates how traditional concepts of learning and creativity are evolving as human collaboration with GAI is becoming normalized. Additionally, the textbook brings forth numerous challenges educators face, such as the ease of creating deep fakes, preserving academic integrity, data privacy, copyright concerns, harmful biases, and overreliance on technology in an AI society.

We call on teacher education programs across Canada to provide continuing professional development in AI literacy for educators at all stages, from faculty members to preservice and in-service teachers. Artificial intelligence literacy in Canadian schools and education systems will grow as we share visions and strategies that promote inclusive and equitable practices, drawing from our collaborative self-study and the related literature reviewed as part of this research. We acknowledge there is no easy or safe road ahead. Integrating GAI into classrooms is risky, and so is leaving it out of classrooms. Faculties and colleges of education across Canada must work together, planning carefully to navigate the tensions, to cultivate a culture of AI literacy in our schools and beyond. Given GAI's profound impact as a disruptive technology, nationally and globally, the need for leadership is urgent.

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Appendix

1. Give one word to describe your GAI book chapter.
2. What is the greatest thing about your book chapter (something that you are proud of or that you accomplished)?
3. What was the hardest or most frustrating part of researching, writing, or designing your book chapter?
4. How can the process of co-authoring an open textbook be improved?
5. Did you learn any new technical skills or GAI skills? If yes, please elaborate.
6. How did the collaborative peer learning environment in the course influence or support your learning?
7. How do you envision using GAI in your work as a teacher or as a student in your future academic pursuits?
8. How confident are you in your ability to discern the ethical considerations and potential biases associated with using GAI and chatbots?
9. Which features of GAI do you find the most valuable for teaching and learning?
10. Overall, how do you feel about the potential impact of GAI on education and the creation of instructional materials?

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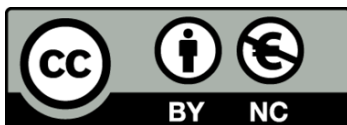
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