From Prompt to Practice: Leveraging Generative AI in Undergraduate Creation of K12 Teaching Resources

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Her dissertation investigates a multi-level intervention framework that engages undergraduate students, K12 teachers, and K12 students in the design, evaluation, and implementation of generative AI–supported instructional materials. Centered on an undergraduate course, her work examines how students develop AI literacy through artifact creation, how teachers evaluate the quality and classroom readiness of AI-generated materials, and how these materials function in authentic K12 classroom settings.

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1 Introduction

1.1 AI in K12

In recent years, the rapid advancement of AI technology has led to increased concerns among teachers regarding AI in education [1]. Since the release of ChatGPT in November 2022, a steady stream of misconceptions and concerns about artificial intelligence has continued to circulate. Many people worry that AI will take over human jobs entirely [2], rendering certain professions obsolete, or that it will replace human creativity and critical thinking altogether. While some existing roles may be displaced by AI, recent analysis highlights that this shift is accompanied by the emergence of entirely new job categories [3]. Yet even in an AI-driven future, the role of teachers remains essential—no technology can fully replace the human connection, guidance, and adaptability that educators provide. Instead, AI offers a way to reduce teachers' workload and extend their capabilities, supporting rather than replacing the human element they offer [4]. In education, these concerns are further amplified by fears that students might misuse AI to bypass learning [5] or that the use of AI tools may result in the loss of critical thinking skills [6]. Additionally, some teachers feel unprepared to integrate AI tools due to limited experience or background knowledge [7].

These concerns are understandable, given AI's rapid growth. However, teacher professional development can be implemented to increase teachers' trust in AI and alleviate common fears about its integration [8, 9]. This can also equip teachers with the knowledge and tools to meaningfully integrate AI into their classrooms—such as generating teaching resources, designing assignments that involve student use of AI (e.g., prioritizing process over output [10]), or creating activities intentionally structured around AI (e.g., AI-resistant or "AI-proof" assignments) [11, 12]. Assignments built specifically around using AI during completion helps students learn how to engage with these tools critically and ethically. With targeted professional development and ongoing support, teachers can gain the skills and confidence to use AI meaningfully, making it a valuable resource to enhance teaching and learning rather than a threat.

While legitimate concerns exist about the use of AI in K12, it is crucial for the future of our youth that they are educated about AI technology and not restricted from using it. Around 30% of school districts in the U.S. have banned access to ChatGPT [13]. Shielding students from AI won't prepare them for a future shaped by it; alarmingly, nearly half of Gen Z struggles to identify basic limitations of AI systems, such as their tendency to generate false information [14].

Meanwhile, AI use in the workplace has nearly doubled over the past two years, with 27% of white-collar employees now reporting frequent use of AI on the job [15], and by 2030, a great majority of employers (86%) expect AI to fundamentally change their operations [16]. We have a responsibility to educate youth about technology, just as we did with computers, the internet, and other transformative tools [17, 14].

The integration of AI education into K12 curricula holds significant benefits for both students and teachers. AI can make learning more engaging, interactive, and personalized. More specifically, generative AI can offer personalized learning paths [18, 19], peer collaboration [20], and additional tutoring support beyond classroom hours [21]. It also equips students with future-ready skills essential for a workforce increasingly reliant on computing technology [22] and makes learning more engaging, interactive, and personalized.

AI literacy empowers teachers to integrate advanced technologies into their instruction, enhancing their professional growth and expanding career opportunities [23]. When teachers are equipped with AI skills, they can utilize generative AI to reshape their traditional teaching practices by streamlining administrative tasks [24], improving grading efficiency [25], and supporting the creation of personalized educational materials [26]. It shows promise in generating instructional content tailored to classroom needs [27]. By reducing routine workload, AI allows educators to focus more on meaningful instruction and personalized support [28, 29]. Ensuring that all students, regardless of background, benefit from these innovations also contributes to more equitable learning environments.

1.2 An Undergraduate Course for AI-Driven Instructional Design

This work is grounded in the development and initial implementation of a new undergraduate course (ITCS 3050: AI Literacy and Computational Thinking) designed to increase student AI literacy while engaging students in the creation of AI-powered K12 instructional materials. While prior work has begun to examine the use of GenAI in educational contexts, it has not yet adequately explored how engaging students in the authentic design of GenAI-supported instructional materials shapes their own learning and understanding of AI. Moreover, limited research has examined how K12 teachers evaluate and perceive the classroom readiness of AI-generated instructional artifacts.

The present study addresses the first of these gaps by centering on student learning during the creation process. Specifically, we examine how engaging in the iterative design of GenAI-powered K12 teaching materials shapes students' perceptions of AI's educational applications and their own AI literacy. Within ITCS 3050, students are positioned not merely as users of AI tools but as designers responsible for developing instructional artifacts intended for authentic classroom contexts. This paper therefore focuses exclusively on a thematic analysis of undergraduate student reflections to investigate how students make sense of their experiences designing with GenAI and how those experiences shape their understanding of AI and its role in education.

The evaluation of these artifacts by practicing K12 teachers represents the next phase of the broader project. While preliminary teacher feedback has been collected, analysis of teacher evaluations will be reported in future work. By separating these strands, this paper concentrates specifically on student learning outcomes, while future studies will examine practitioner perceptions and artifact quality through structured teacher evaluation instruments. The following research questions guide this study.

1. How do students frame their experiences developing K12 teaching materials?
2. What growth do students report in their understanding of AI literacy after engaging in the design of GenAI-generated K12 teaching resources?
3. What difficulties do students experience in learning to use GenAI for instructional design?

2 Related Work

While no prior work has highlighted the experience of undergraduate computer science students using AI tools to generate K12 teaching resources, this study builds on existing research related to AI in education, including teacher and student perspectives on AI, the use of AI tools in K12 and higher education classrooms, and professional development aimed at improving educators' understanding of AI. Additionally, there has been emerging work on co-designing AI-generated learning materials in partnership with K12 teachers [30], highlighting the value of collaborative approaches to integrating AI into instructional design.

2.1 Teacher Perspective of AI

Much research has examined the perspectives of both K12 and college educators regarding the impact of AI on education and their views on its integration into the classroom. Some instructors may fear ChatGPT because AI is complex and unfamiliar. When its capabilities aren't well understood, it can create uncertainty and anxiety [31]. While some research has documented common concerns and challenges teachers face when integrating AI [32, 33], there are also numerous examples of educators reporting positive and productive experiences with its use [34, 35, 36]. Shi et al. [34] describes the experience of science teachers using an AI-enabled inquiry intelligent tutoring system (Inq-ITS) in their classroom. While teachers previously reported their primary role as "a classroom manager and a guide" or "just maintaining order", after using Inq-ITS, they reported their primary role as "helping students be deeper thinkers" and "being the person to help students' specific needs" [34].

2.2 Student Perspective of AI

Additionally, studies have investigated students' perceptions of AI and how they incorporate it into their everyday lives [37, 38, 39]. In contrast to widespread concerns among educators about students using AI to plagiarize, one education report found that college students primarily use AI to support higher-order thinking tasks such as creative work and analytical reasoning [40]. This challenges common misconceptions about student use of AI. Another study found that 46% of students use AI in their learning everyday to 3-4 times a week, while only 20% reported never using it [39]. These findings underscore the importance of educating students about AI's capabilities, limitations, and ethical implications.

2.3 AI in the K12 Classroom

The AI4K12 “Five Big Ideas” framework [41] serves as a foundation for many current efforts to integrate AI into K12 education. Its five core concepts—Perception, Representation and Reasoning, Learning, Natural Interaction, and Societal Impact—offer a structured approach to introducing students to the fundamental principles of artificial intelligence. Many initiatives recommend aligning AI education with existing computer science (CS) curricula [42], which is a logical starting point given the conceptual overlap. However, as AI increasingly shapes all facets of society, there is a need to extend its integration beyond CS into other subjects. This approach is also limited by the fact that adoption of CS standards has been gradual, with only 58% of U.S. high schools currently offering foundational computer science courses [43]. The urgency to broaden AI education is reinforced by the 2025 Executive Order calling for expanded AI literacy among youth [44].

2.4 Instructional Approaches for Teaching AI

There are two main approaches to introducing AI or computational thinking (CT) in K12 education: ”unplugged” and ”plugged” activities. Unplugged activities aim to teach CS or AI concepts without the use of technology. These may involve collaborative table work, hands-on games, or movement-based exercises that engage students in problem-solving or conceptual thinking. In contrast, plugged activities incorporate the use of digital tools or devices to directly teach CS or AI concepts. The effectiveness of each approach often depends on factors such as the students’ grade level and the complexity of the concepts being introduced.

Unplugged activities are often more effective for engaging younger learners, such as those in elementary and middle school, with foundational CS and AI concepts [45]. They also offer a flexible, accessible option for teaching AI in settings where access to technology may be limited or inconsistent [46]. Plugged activities can be effective across all grade levels when designed with appropriate simplicity—such as using tools like Scratch for younger students [47, 48]. At the middle and high school levels, plugged activities are especially valuable for introducing more advanced AI and computing concepts through hands-on interaction with technology [49, 50].

3 Course Design

3.1 Course Theoretical Foundations

The developments described in the Introduction underscore a growing urgency to prepare both students and teachers to navigate and shape a world increasingly influenced by AI. While efforts have emerged to increase AI literacy in K12 settings through curriculum frameworks, professional development, and instructional tools, limited research has examined how undergraduate computer science students might contribute meaningfully to this effort through structured, pedagogically grounded design experiences. ITCS 3050 was intentionally designed using established learning theories to support both conceptual understanding and applied instructional development.

The course draws on constructivist principles [51], experiential learning theory [52], and the backward design model [53]. Consistent with constructivism, students actively constructed understanding through iterative design tasks, peer discussion, and reflection rather than passive exposure to AI content. Experiential learning informed the emphasis on hands-on artifact creation, requiring students to apply abstract AI concepts in authentic instructional contexts. Backward design principles guided the alignment of learning objectives, instructional activities, and final deliverables, ensuring that artifact development was anchored in clearly defined educational goals rather than technology-driven exploration alone. Course topics were scaffolded throughout the semester in alignment with the zone of proximal development [54], gradually increasing complexity while providing structured support.

The course learning objectives were designed to operationalize these theoretical commitments. By the end of the semester, students were expected to:

1. Explain foundational AI concepts, including how AI systems learn, make decisions, and generate outputs.
2. Apply principles of lesson design, including identifying target grade levels, writing measurable objectives, and aligning instructional materials with intended learning outcomes.
3. Translate technical AI concepts into developmentally appropriate explanations for K12 audiences.
4. Design engaging instructional experiences, including interactive or unplugged activities, grounded in educational best practices.
5. Use generative AI tools strategically and iteratively to support instructional goals.
6. Develop a comprehensive instructional package that integrates pedagogical planning with AI-generated artifacts.

Collaborative, team-based activities were intentionally structured to reflect experiential and socially mediated learning processes [55]. Students engaged in iterative cycles of design, feedback, and refinement, reinforcing both conceptual understanding and pedagogical reasoning. Through this framework, generative AI functioned not as the starting point of the course, but as a culminating tool embedded within a broader instructional design process.

3.2 Course Structure and Content Topics

The course was intentionally scaffolded to prepare undergraduate computer science students, most of whom did not have formal training in education, for the task of designing instructional materials intended for K12 audiences. Rather than beginning with generative AI tools, the course first established foundational knowledge in artificial intelligence concepts, including how AI systems learn, make decisions, and interact with the world. Students examined common misconceptions and ethical considerations surrounding AI before transitioning into hands-on computational activities using Scratch. Through Scratch and its AI extensions such as speech-to-text and text-to-speech, students developed interactive projects that introduced basic AI functionality in developmentally appropriate ways.

Midway through the semester, the focus shifted to pedagogical preparation. Students were introduced to core principles of lesson design, including identifying target grade levels, aligning content to standards, writing measurable learning objectives, and structuring age-appropriate instructional activities. They examined examples of effective K12 lessons and discussed strategies for building engaging narratives, designing interactive experiences, and creating unplugged activities suitable for elementary and middle school learners. Students also practiced translating technical concepts into explanations that would be accessible and meaningful for younger audiences. Only after this foundation in instructional design, audience awareness, and educational alignment was established were students introduced to generative AI tools for image and video creation.

Generative AI was introduced during the final portion of the semester as one component of a broader instructional design process rather than as the central focus of the course. Students learned how to craft effective prompts, iteratively refine outputs, evaluate AI-generated content for accuracy and appropriateness, and document their prompting process. This sequencing positioned generative AI as a tool to support instructional goals that had already been defined, rather than as a replacement for pedagogical decision making.

As the culminating assignment, students worked in groups to develop a comprehensive instructional package consisting of four key deliverables. First, they created a 4 to 5 minute animated video generated using a GenAI tool of their choice, accompanied by documentation of the initial and refined prompts used. Second, they designed an interactive game, typically built in Scratch, that took approximately 4 to 5 minutes to complete and included a narrative element to support conceptual understanding. Students who opted to design an unplugged activity in place of the game were required to produce an additional AI-generated video explaining the activity. Unplugged activities were designed to take 20 to 30 minutes for a classroom to complete. Each artifact was supported by a detailed teacher guide that included a lesson plan, overview of the topic, learning objectives, classroom setup instructions, and recommended grade level. One instructional resource was required to focus on a K12 AI literacy concept, while the other addressed a specific math or science topic aligned to a chosen grade band. The final submission was designed to be usable by K12 educators, including those with limited technical or AI experience.

3.3 Instructional Artifacts

For the final project, there were 8 groups of 3-4 students. This resulted in 16 artifacts with instructions and lesson plans for each. The totals for artifacts are shown below. The unplugged and plugged activities add up to 9 total because one group created an unplugged activity to go with their 4-5 minute AI lesson.

- 4-5min AI lesson: 8
- Unplugged activity: 4
- Plugged Activity: 5

Table 1 summarizes the instructional artifacts created by students, detailing the topic area, intended grade level, artifact type, and whether the activity was implemented as a video lesson, unplugged, or plugged experience.

Table 1: Final Group Project: Artifact Overview

Artifact type	Implementation	Audience	Topic area	Lesson Title
GenAI video	Video Lesson	grade K-5	AI	Overview of AI
GenAI video	Video Lesson	grade 3-5	AI	Introduction to Prompt Engineering
GenAI video	Video Lesson	Teachers	AI	How AI Transforms Teaching
GenAI video	Video Lesson	grade 9-12	AI	Overview of AI
GenAI video	Video Lesson	grade K-5	AI	Basics of AI
GenAI video + game	unplugged	grade 4–7	Science	Buoyancy, Density, and its applications
GenAI video	Video Lesson	grade 3–6	AI	AI basics for young learners
GenAI video	Video Lesson	grade 8-12	AI	Overview of AI
game + GenAI video	unplugged	grade K-5	Science	Protecting Our Environment: What's Good and Bad
game + GenAI video	unplugged	grade K-5	Science	Photosynthesis
game + GenAI video	unplugged	grade K-5	AI	Think Like a Robot: Writing Simple Algorithms
game using AI image generator	plugged	grade 3-5	AI	Creating with Prompts: AI-Generated Images
Scratch game with AI extensions	plugged	grade 3-5	Math	PEMDAS
game created using AI website generator	plugged	grade 3-5	Math	Wizard's Workshop: Brewing Math Skills
Scratch game with AI extensions	plugged	grade 3-6	Math	The Castle Countdown: Math Your Way to the Treasure
Scratch game with AI extensions	plugged	grade 3-5	Science	Building Circuits: Conductors, Insulators, and Flow

4 Methods

4.1 Data Collection

Data for this study were collected through a final written reflection submitted by students at the conclusion of the course. The reflection served as the primary data source for the thematic analysis presented in this paper. The purpose of the reflection assignment was to capture students' perceptions of their learning experiences, including how their understanding of AI evolved, their experience using generative AI tools for K12 content, and how they engaged with the design of K12 instructional materials. In addition to informing this research, the reflections were also used formatively to guide iterative improvements to future offerings of the course. Students were prompted to write a response of at least 500 words addressing multiple aspects of their experience. Specifically, they were asked to reflect on their initial knowledge of AI and how it changed over the semester; their expectations for the course and how those expectations compared to their actual experience; their personal growth related to (a) AI literacy, (b) AI tools and concepts, and (c) generating instructional materials for elementary and middle school audiences; and recommendations for future improvements to the course. An open-ended section allowed students to provide any additional thoughts they felt were relevant. These structured yet open-ended prompts were designed to elicit rich, reflective narratives that captured students' perceived growth, challenges, and evolving perspectives regarding the use of generative AI in educational contexts.

4.2 Thematic Analysis of Final Reflections

In Spring 2025, 25 of 26 enrolled students completed this reflection. The reflections were de-identified and randomly assigned numbers (e.g., "Reflection 7") prior to analysis. A systematic manual thematic coding approach was used to analyze the qualitative data. Initial themes were developed through a preliminary reading of the reflections, resulting in a provisional coding framework that guided subsequent analysis. The data were then examined sentence by sentence, with each meaningful unit evaluated for alignment with existing themes or the emergence of new, unanticipated ones. This iterative process supported both deductive coding, informed by the initial framework, and inductive coding grounded in the data. When new themes emerged, they were documented and incorporated into the evolving codebook. Analytic memos were maintained throughout to capture reflections, emerging insights, and refinements to the thematic structure. Following the initial round of coding, themes were reviewed, refined, and consolidated to ensure conceptual coherence and clarity.

5 Results

Through the thematic coding process, theme categories, themes, and subthemes emerged. Table 2 presents these and illustrates the relationships among categories, themes, and subthemes and provides counts where relevant.

Below, each theme category, theme, and subtheme is listed, as well as a student quote that exemplifies the respective theme or subtheme. These themes are examined in greater depth in the Discussion section.

5.1 Evolving Knowledge of Artificial Intelligence

5.1.1 Understanding Ethical and Educational AI Applications

”It was so amazing to see the actual impacts of AI, rather than just focusing on its development. Something that I think needs to be focused on as AI develops is absolutely regulations. As important and revolutionary as this topic is, without regulations, AI is a powerful enough tool to risk being abused. We don’t want a tool as important to become accessible because of that abuse. Regulation is the only way to protect civilians, and I think it should be looked into as we grow.”

5.1.2 Building Technical Proficiency in AI and Scratch

”But after reading things like the ‘AI in 5 Minutes’ video and working through exercises, I got a better grasp on how AI works. I realized AI isn’t just one thing—there are different concepts like pattern recognition and machine learning that come together to make things like voice assistants or movie recommendations. That was one of the coolest takeaways from the course. I also learned how to use AI tools like the Teachable Machine, and I was surprised by how easy it was to create something that responds to input like a webcam or microphone.”

5.2 Baseline AI Knowledge

5.2.1 Reported AI Experience Before the Course

”I see myself as an experienced student when it comes to concepts within artificial intelligence. Before taking this course, I was already well-versed in the field of computer science; however,

Table 2: Thematic Codes Summary

Theme Category	Theme	#	Subtheme	#
Evolving Knowledge of Artificial Intelligence	Understanding Ethical and Educational AI Applications	16		
	Building Technical Proficiency in AI and Scratch	21		
Baseline AI Knowledge	Reported AI Experience Before the Course	7		
	Limited or No Prior AI Experience	18		
Perspectives on AI in Educational Practice	AI enables accessibility for both teachers and students	7		
	Adapting Knowledge for Young Minds	17		
	Change in Perception of Education	3		
	AI literacy is important for young minds	5		
Learning Experiences in the Course	Initial Perceptions and Expectations	19	Experiential Learning Beyond Initial Expectations	9
			Unanticipated Emphasis on Designing for Young Learners	4
			Expectation of Greater Technical Depth	6
	Positive Student Experiences	25		
	Challenges and Areas for Improvement	25	Calls for Stronger Coverage of AI Ethics	4
			When Scratch Feels Like Busywork	7
			Designing for Real Teachers, Not Just Assignments	7
			Opportunities to Improve Course Clarity and Organization	9
			Desire for Greater Technical Depth	4

Note. 25 out of 26 enrolled students submitted a final reflection, which serves as the data source for this analysis.

now that we are approaching the end of the semester, I can say I've definitely picked up some new things."

5.2.2 Limited or No Prior AI Experience

"Coming into this course, my understanding of artificial intelligence (AI) was basic at best. I was aware of its growing presence in society—especially in areas like recommendation systems, automation, and chatbots—but I had little knowledge of its pedagogical relevance or the depth of ethical and technical considerations that come with using AI in education."

5.3 Perspectives on AI in Educational Practice

5.3.1 AI enables accessibility for both teachers and students

"This course made me realize that AI could greatly benefit younger students and teachers. Our final project proved that AI can create great ideas for activities and can even create lesson videos from scratch. This made me reflect on how it can enable teachers to create more engaging lessons in a very fast and easy manner."

5.3.2 Adapting Knowledge for Young Minds

"My experience with generating materials for elementary and middle school was interesting and at times somewhat challenging. As a college student, I sometimes found it difficult to put myself in the shoes of a younger student. Creating materials required me to simplify complex and abstract AI concepts without losing their meaning, while also being engaging and age-appropriate."

5.3.3 Change in Perception of Education

"It was interesting to see the other perspective of teaching in a sense. One of my part-time jobs on campus is as a Communications Consultant for a Spanish instructor here on campus, so I already had some perspective on the teacher's side of things. But this is one of the first times I had to plan out a lesson, make the guidelines, and really try to make everything cohesive. It was actually a worthwhile experience, and I'm glad I was able to take this course this semester."

5.3.4 AI literacy is important for young minds

"This course broadened my perspective by showing how literacy, especially when discussing AI, is becoming increasingly more important for all age groups, and how there are tools we can use to empower young students to become literate in such a strong way."

5.4 Learning Experiences in the Course

5.4.1 Initial Perceptions and Expectations

Experiential Learning Beyond Initial Expectations. "At the beginning of the semester, I honestly didn't know what to expect from this course. I thought it was going to be more about the backend of AI and machine learning rather than actually using AI tools to create things like the games we made in Scratch. I was surprised by how hands-on and creative this course turned out to be. I really liked that we had the chance to build things instead of just talking about AI in theory, because it made the whole subject feel more real and understandable."

Unanticipated Emphasis on Designing for Young Learners. "In the beginning of the semester, using AI for teaching wasn't really on my mind. I am more interested in how AI works and how I can create my own AI models. So when I signed up for this class, I saw 'AI' in the title and thought, 'Cool, this will probably be about AI technology and tools.' I didn't realize it would be so focused on K12 education, which honestly wasn't what I expected."

Expectation of Greater Technical Depth. "Before the first day of class, I thought this course would be heavily dependent on hard programming, but in reality, it was basically testing how well we could adapt to new concepts and languages within artificial intelligence."

5.4.2 Positive Student Experiences

"It has been a privilege to be part of this course and to contribute to something that has the potential to shape the future of education. I appreciate the creativity and freedom we were given to explore AI tools in innovative ways. I hope this class continues to grow and inspire more students to think critically about the role of AI in our world. Thank you for providing such a meaningful and impactful learning experience."

5.4.3 Challenges and Areas for Improvement

Calls for Stronger Coverage of AI Ethics. "My first recommendation is to include more discussion on ethics and implications of AI and introduce a bit more variety in AI tools and topics. We did touch on ethics and societal impacts of AI in class discussions, but these felt brief compared to the hands-on activities."

When Scratch Feels Like Busywork. "However, my experience with Scratch was tedious and time-consuming. Although Scratch is a great tool for K12 students to learn basic programming and computational thinking, creating games based on block coding was tedious, as it was often based on repetitive actions."

Designing for Real Teachers, Not Just Assignments. "To enhance this course and make it more useful, I think it would be a great idea to partner with elementary and middle schools in the area and present the lessons students created for their final projects to see how K12 students actually engage with the material. Doing so would give students more insight and make them more motivated to improve their projects once they see the feedback firsthand."

Opportunities to Improve Course Clarity and Organization. "Oftentimes the course felt a bit structureless, in the sense that sometimes the topics in class felt like they were just tossed in the air. While that's not necessarily a bad thing, I feel like there could be a bit of added structure—not so rigid that it feels strict, but enough for everything to feel more cohesive."

Desire for Greater Technical Depth. "Personally, I already had knowledge of many of the concepts before the course, but I still feel like we could have gone deeper into what AI is. Topics like different machine learning methods and even pseudocode would have been helpful. I think this approach is more effective, as we learn about AI while also learning how to teach the concepts. Overall, I think the class was structured well and had great intentions, but it could have been a bit more complex."

6 Discussion

6.1 How do students frame their experiences developing K12 teaching materials?

Students framed their experiences developing K12 teaching materials in ways that extended beyond technical interaction with AI tools. Rather than focusing solely on tool proficiency, many described shifts in how they understood teaching, accessibility, and the broader educational implications of AI. Interpreted through a constructivist lens [51], these reflections suggest that designing for younger learners required students to reconstruct their own understanding of AI within a new instructional context. The act of creation functioned not only as a product-oriented task, but as a mechanism for deeper conceptual reorganization. Experiential learning theory [52] further clarifies these findings. Students were engaged in authentic design tasks that required them to move from abstract AI knowledge to concrete instructional application. Through iterative creation, feedback, and revision, they encountered the practical constraints of age appropriateness, clarity, and engagement. These experiences appear to have shaped how they framed AI's role in educational settings, reinforcing the idea that applied instructional design can function as a catalyst for reframing technological understanding.

6.1.1 AI Enables Accessibility for Teachers and Students

In 7 out of 25 reflections, students described AI as a tool that could enhance accessibility for both teachers and learners. Rather than viewing AI primarily as a technical system, students framed it as a support mechanism for lesson planning, differentiation, and student engagement. From a backward design perspective [53], this suggests that students began to consider how AI tools align with instructional goals and learner needs. Their reflections indicate movement toward outcome-oriented thinking, where AI is evaluated not by novelty but by its capacity to support learning objectives and reduce barriers.

6.1.2 Adapting Knowledge for Young Minds

The most prominent subtheme, appearing in 17 out of 25 reflections, involved translating complex AI concepts into developmentally appropriate explanations. This process required students to reconsider what they knew and how they communicated it. From a constructivist standpoint, teaching others often deepens understanding because it demands conceptual clarity and restructuring. Students were required to simplify without distorting, engage without overwhelming, and scaffold explanations for younger audiences. This aligns closely with experiential learning, as students learned by doing, revising, and reflecting on how their materials might function in real classrooms.

Importantly, this subtheme also reflects backward design in practice. Students had to begin with a target audience and intended learning outcomes, then design materials aligned to those goals. Their reflections suggest that the discipline of designing for K12 learners reshaped how they conceptualized AI itself, shifting focus from technical complexity to clarity, purpose, and accessibility.

6.1.3 Change in Perception of Education

Although only 3 out of 25 students explicitly reported a shift in how they viewed education or teaching, these reflections are theoretically significant. For these students, engaging with AI in an instructional context prompted reconsideration of the educator's role and the responsibilities associated with integrating emerging technologies into classrooms. From a constructivist perspective, this indicates identity-level learning, where students begin to see themselves not only as technologists but as instructional decision-makers. Even at a smaller scale, these shifts suggest that AI-focused coursework can influence how undergraduates conceptualize the profession of teaching.

6.1.4 AI Literacy Is Important for Young Minds

In 5 out of 25 reflections, students emphasized the importance of AI literacy for K12 learners. These reflections demonstrate movement beyond personal skill development toward broader societal awareness. Students recognized that AI is increasingly embedded in daily life and that early exposure can support critical and responsible engagement. This aligns with the course's constructivist and experiential orientation, as students developed this awareness through the act of designing materials intended for younger audiences. By positioning students as creators of AI literacy content, the course appears to have encouraged forward-looking thinking about the role of AI education in shaping future learners.

Taken together, these findings suggest that engaging undergraduates in the creation of GenAI-supported K12 instructional materials does more than build technical competence. The design process itself appears to reshape how students conceptualize accessibility, instructional responsibility, and the societal importance of AI literacy. Interpreted through constructivism, experiential learning, and backward design, these shifts highlight the value of positioning students as instructional designers rather than passive consumers of AI tools.

6.2 What growth do students report in their understanding of AI literacy after engaging in the design of GenAI-generated K12 teaching resources?

6.2.1 Evolving Knowledge of Artificial Intelligence

Student reflections suggest meaningful perceived growth in AI literacy across multiple dimensions. Rather than attributing this growth solely to exposure to AI tools, the findings can be interpreted through the constructivist and experiential foundations of the course. Students were not positioned as passive recipients of AI knowledge. Instead, they engaged in iterative design, collaborative discussion, and artifact creation, constructing understanding through authentic application. From a constructivist perspective [51], learning occurred as students actively made sense of AI concepts within meaningful social and instructional contexts. Experiential learning theory [52] further helps explain this growth, as students cycled through concrete creation, reflection, and refinement while developing instructional materials.

By the end of the course, students reported growth across two complementary dimensions of AI literacy: technical understanding and responsible, ethical awareness. Many described shifting from viewing AI as a shortcut or novelty to recognizing it as a complex system with educational, societal, and ethical implications. Students demonstrated a more nuanced understanding of AI's capabilities and limitations, acknowledging that outputs are shaped by human input and therefore require oversight and critical evaluation.

Two dominant themes aligned with these dimensions. "Understanding Ethical and Educational AI Applications" appeared in 16 out of 25 reflections, while "Building Technical Proficiency in AI and Scratch" appeared in 21 reflections. The higher frequency of technical growth aligns with the experiential structure of the course, which emphasized hands-on experimentation, model interaction, and artifact development. From a backward design perspective [53], this suggests that the most visible learning outcomes were those most directly embedded in repeated practice and deliverables. Although ethical awareness was present, the data indicate that ethical reasoning may benefit from deeper integration into the design process rather than remaining a complementary strand. These findings suggest that AI literacy development is strengthened when technical skill-building and ethical reasoning are intentionally interwoven within authentic design tasks. Future iterations of the course can more deliberately integrate responsible AI analysis into artifact evaluation and revision cycles, ensuring that ethical considerations are constructed alongside technical competence rather than appended to it.

6.2.2 Baseline AI Knowledge

Variation in baseline knowledge further illustrates the constructivist nature of the learning environment. Because the course has no prerequisites, students entered with diverse prior experiences. From a constructivist standpoint, this diversity reflects different starting points within each student's zone of proximal development [51]. Growth, therefore, must be interpreted relative to initial knowledge rather than as a uniform outcome.

Reported AI Experience Before the Course. Seven out of 25 students reported prior experience with AI, often through previous coursework or independent exploration. These students tended to report less perceived growth and, in some cases, expressed interest in deeper technical exploration. Their reflections highlight a natural tension in designing an AI literacy course for a mixed-experience cohort. While the course emphasizes accessibility and pedagogical translation for K12 contexts, students with advanced backgrounds may seek additional technical complexity.

From a backward design perspective, however, the course's objectives prioritize the ability to explain, adapt, and responsibly apply AI concepts for K12 audiences rather than mastery of advanced systems. Increasing technical rigor without revisiting those objectives could shift the course away from its intended purpose. That said, these reflections suggest that modest conceptual enrichment opportunities may better differentiate instruction while maintaining alignment with the course's central goals.

Limited or No Prior AI Experience. In contrast, 18 out of 25 students reported limited or no prior experience with AI. For these students, reflections frequently described initial uncertainty followed by increased confidence and understanding. This pattern is consistent with experiential learning theory, as students gained competence through structured practice, feedback, and iterative creation. The open enrollment structure appears well aligned with learners at early stages of AI exposure, particularly those developing foundational literacy and pedagogical translation skills.

Collectively, these findings highlight the complexity of designing AI literacy experiences for heterogeneous student populations. At the same time, they reinforce the value of grounding AI instruction in authentic, pedagogically oriented design tasks. When students are required to translate AI concepts for younger learners, they move beyond surface-level familiarity and toward deeper conceptual understanding. This suggests that instructional design itself may function as a mechanism for strengthening AI literacy, particularly when supported by scaffolded, theory-informed course structures.

6.3 What difficulties do students experience in learning to use GenAI for instructional design?

Student-reported difficulties illuminate not only practical frustrations but also productive tensions inherent in constructivist, experiential course designs. Rather than viewing these challenges as isolated shortcomings, they can be interpreted as indicators of cognitive stretching within a scaffolded learning environment. Across reflections, students described ethical gaps, frustration with tools, tensions between coursework and authentic practice, organizational concerns, and a desire for greater technical depth. Interpreted through the theoretical framework guiding the course, these difficulties reveal boundary conditions of experiential AI literacy instruction and suggest refinements that strengthen alignment between theory and implementation.

From a constructivist perspective [51], moments of friction often signal engagement within the zone of proximal development. Students were not simply consuming AI content but actively constructing knowledge through design, critique, and iteration. Several reported that ethical discussions felt brief relative to technical activities. This concern suggests that while students were successfully constructing procedural and conceptual AI knowledge, structured opportunities for critical reflection on ethics may need stronger integration throughout the design cycle. Embedding ethical reasoning directly into artifact development would more fully align with constructivist principles by positioning ethics not as a standalone topic, but as a lens applied during authentic creation.

Frustrations with Scratch and perceptions of “busywork” can similarly be interpreted through experiential learning theory [52]. Experiential models emphasize concrete experience followed by reflection and conceptual integration. For students with prior programming experience, repetitive Scratch tasks may have reduced perceived novelty or challenge. However, Scratch functioned as a pedagogical constraint that required students to translate complex ideas into accessible, developmentally appropriate forms. The tension between prior expertise and simplified tools reflects a shift from programmer identity to instructional designer identity. These findings suggest that experiential AI literacy courses must balance accessibility tools with differentiated pathways to sustain engagement while preserving pedagogical purpose.

Student calls for stronger connections to real classroom contexts further reinforce the experiential framework. Experiential learning emphasizes authentic application, and students expressed a desire to see how their materials function in real K12 environments. This aligns with backward design principles [53], which stress alignment between intended outcomes and authentic performance tasks. When assignments feel disconnected from classroom implementation, students may perceive a theory–practice gap. Planned partnerships with outreach courses directly respond to this concern by strengthening outcome alignment and situating artifact creation within observable educational impact. This refinement more fully operationalizes backward design by making the “transfer” phase of learning visible.

Concerns about clarity and organization can also be interpreted through backward design. When expectations, pacing, or assessment criteria are unclear, alignment between learning objectives, activities, and deliverables weakens. Student feedback in this area does not suggest rejection of the course goals but rather a need for stronger structural coherence to support them. Iterative refinements in later course offerings reflect a maturing alignment between theoretical commitments and logistical execution.

Finally, the desire for greater technical depth highlights an important boundary of the course design. While some students expressed interest in more advanced topics such as machine learning or robotics, the course was intentionally focused on AI literacy and the ability to translate AI concepts for K12 learners rather than on technical specialization. While the course emphasizes translating and responsibly applying AI concepts for K12 audiences over advanced technical mastery, future iterations may include deeper conceptual explanations and limited exposure to more complex AI tools without shifting its pedagogical focus.

Taken together, these reported difficulties do not undermine the course framework. Instead, they reveal productive tensions inherent in constructivist and experiential AI literacy instruction. The findings suggest that preparing undergraduates to design AI-supported instructional materials requires deliberate integration of ethics, differentiated technical pathways, strengthened authenticity, and continued refinement of structural alignment. These insights extend existing discussions of AI literacy by identifying the pedagogical adjustments necessary when shifting from AI tool use to AI-informed instructional design.

7 Future Work

Although a teacher workshop and artifact feedback session was conducted in Summer 2025, that work falls outside the primary scope of the present paper. This study focuses specifically on themes derived from student reflections collected during the first iteration of the course. However, preliminary findings from the Summer 2025 teacher session provide promising early insights. During this initial feedback workshop, K12 teachers reviewed selected undergraduate-created GenAI instructional artifacts. Many teachers indicated that they would be interested in using AI-generated materials similar to the student artifacts in their own classrooms, with several reporting that they would consider using certain videos without requiring modifications. Notably, no teachers indicated that they would be unwilling to use AI-generated instructional content, even if revisions were made. These early findings suggest a strong level of openness among participating teachers toward undergraduate-generated GenAI materials and support continued investigation of this instructional design model.

Future work will report in detail on the Summer 2025 teacher feedback and examine how practitioner input informed revisions implemented in the second and third iterations of the course. In addition, subsequent studies will include a comparative analysis of themes emerging from student reflections across the first, second, and third iterations of the course, providing insight into how instructional refinements shaped student experiences and perceived learning outcomes over time.

Future iterations will also expand authentic implementation opportunities through a structured partnership with a separate computer science course focused on K12 outreach, in which undergraduate students teach computational thinking lessons in local classrooms. As part of this collaboration, selected students from the partner course will integrate a student-created GenAI video from this course into their lesson and report back on K12 student engagement and classroom response. This design will enable examination of how student-generated GenAI materials function in authentic classroom contexts and provide an additional source of practitioner-informed feedback for ongoing course refinement.

We will continue to gather teacher perspectives as part of this longitudinal work. During Summer 2026 workshops, teachers will not only view artifacts from the second and third iterations of the course but will also complete a structured artifact evaluation rubric for each GenAI video that is demoed. This rubric-based feedback will allow for more systematic analysis of instructional quality, accuracy, age appropriateness, engagement potential, and classroom applicability. Collectively, this ongoing data collection will strengthen the evidentiary base for understanding both student learning outcomes and practitioner perceptions of undergraduate-generated GenAI teaching resources.

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