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ORIGINAL CONTRIBUTION

Perceived Pedagogical Benefits of Artificial Intelligence in Technology Education: Insights from Pre-service Teachers

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Abstract— Artificial Intelligence (AI) is increasingly used in education, but evidence about its pedagogical value remains uneven across subject-specific teacher-education contexts. In South African Technology Education, little is known about how pre-service teachers interpret AI's usefulness after direct exposure to AI-supported lesson planning. This study explored pre-service Technology Education teachers' perceptions of the pedagogical benefits of Artificial Intelligence in teaching and learning. The study adopted an interpretivist paradigm, and a qualitative descriptive design was used. Open-ended questionnaire responses were collected from 92 volunteers from an eligible intact cohort of 94 third-year pre-service teachers specializing in Technology Education after a structured AI-supported lesson-planning activity. The open-ended responses were analyzed thematically inductively through familiarisation, coding, pattern identification, and theme development. The Technology Acceptance Model (TAM), specifically perceived usefulness, was applied after inductive theme development as an interpretive lens. Participants perceived AI as useful for personalizing instruction, simplifying complex technological concepts, supporting learner engagement, improving the perceived efficiency of lesson preparation, and enabling rapid assessment feedback. These are perceptions of potential pedagogical value rather than measured classroom outcomes. AI may function as a pedagogical support in Technology Education when its outputs are critically evaluated, contextualized, and aligned with the Curriculum and Assessment Policy Statement (CAPS). The findings support strengthening critical AI literacy in teacher education while preserving teacher judgment and recognizing contextual constraints on implementation.

Index Terms— Artificial Intelligence, Technology Education, Pre-service Teachers, Teacher Education, Technology Acceptance Model

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Introduction

Artificial Intelligence (AI) has started to revolutionize the educational landscape in fundamental ways, changing the generation, access, and mediation of knowledge in classrooms (J. Zhang & Zhang, 2024). The infusion of AI into school-based disciplines, such as Technology, where problem-solving, design thinking, and creativity are integral, is a pedagogical opportunity as well as a conceptual disruption (Sperling et al., 2024; J. Zhang & Zhang, 2024). The use of AI-powered tools is increasingly being promoted as a way to enable personalized learning, adaptive instruction, and more efficient curriculum delivery worldwide. These trends suggest a move away from traditional teacher-centered pedagogies toward more dynamic, learner-responsive approaches that are aligned with the needs of the Fourth Industrial Revolution. However, the translation of technological affordances into meaningful classroom practice has been inconsistent, especially in teacher education programs where prospective educators are still honing their pedagogical identities (Daher, 2025; Dilek et al., 2025; Lee & Bryan, 2025).

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This transition is significant in teacher education because pre-service teachers are simultaneously learning how to teach and honing their judgments about the technologies they might use in classrooms. Therefore, studies have started to explore pre-service teachers' acceptance of AI, AI literacy, and the impact of teacher-training experiences on intentions to use AI (Alejandro et al., 2024; Runge et al., 2025; Sperling et al., 2024). This literature establishes pre-service teachers as an important population for understanding emerging patterns of educational AI use, but does not, on its own, show how AI is perceived within particular school subjects.

Technology Education provides a unique setting to investigate such perceptions. Technology Education is of critical importance in preparing learners for real-world technological challenges in the South African context by equipping them with critical thinking and practical problem-solving skills, as dictated by the Curriculum and Assessment Policy Statement (CAPS) (Education, 2011). The subject is inherently practice-oriented, involving learners in design processes, constructing artifacts, and applying conceptual knowledge in real-life contexts (Education, 2011).

The arrival of AI in this domain raises important questions about how these tools can be used to enhance rather than undermine the epistemic and pedagogical foundations of the subject. There is a possibility that artificial intelligence may support lesson planning, develop instructional resources, simulate real-world scenarios, and provide immediate feedback, but there is a need to critically analyze how these perceived benefits are understood by those who will implement them in classrooms (Bosch et al., 2023; Maimela & Mbonde, 2025; Oyelere & Aruleba, 2025; Phokoye et al., 2025). At the same time, the pedagogical potential of those affordances cannot be taken for granted: Technology Education requires active engagement with design challenges by learners and contextual and professional judgment by teachers.

Emerging practitioners, such as pre-service teachers, are an important group in this discourse. Their perception of AI is influenced not only by their experience of digital resources in higher education, but also by their projected anticipated use of such technologies in their future teaching practice (Kalniņa et al., 2024; C. Zhang et al., 2023). Unlike in-service teachers, whose practices might be bound by institutional routines and resource limitations, pre-service teachers are situated at the nexus of training and innovation, offering valuable insights into future trends in pedagogy (Alejandro et al., 2024; Runge et al., 2025; C. Zhang et al., 2023). Existing research on AI in education has mainly centered on technical capabilities, ethics, and pedagogical potential in general (Alejandro et al., 2024; Kalniņa et al., 2024; Nyaaba et al., 2024).

The central problem of the research is therefore not whether AI has generic educational capabilities, but whether and how those capabilities are perceived as pedagogically useful by pre-service teachers who have themselves engaged directly with AI-supported planning tasks in Technology Education. Similar questions have been studied in earlier work. Studies have looked at pre-service teachers' general acceptance of AI (Alejandro et al., 2024; C. Zhang et al., 2023), AI literacy in teacher education (Daher, 2025; Sperling et al., 2024), and how training and AI-related pedagogical knowledge affect acceptance (Runge et al., 2025). Other work has documented the benefits and challenges of AI for pre-service teachers in higher education (Kalniņa et al., 2024) and broader South African debates about AI-supported learning and curriculum transformation (Bosch et al., 2023; Maimela & Mbonde, 2025; Phokoye et al., 2025). Student perspectives have also been explored in sub-Saharan African programming education (Oyelere & Aruleba, 2025).

Collectively, these studies add to a burgeoning literature but vary in population, disciplinary setting, methodological emphasis, and outcomes of interest. Acceptance studies tend to examine attitudes or intentions toward AI; AI literacy scholarship examines capabilities and critical competencies; and broader higher education studies examine institutional or cross-disciplinary experiences. What is less clear is the perceived pedagogical usefulness of AI as a consequence of participating in an AI-supported lesson-planning activity, relative to the concrete instructional demands of the subject, for pre-service teachers specializing in school Technology Education. This subject-specific and context-sensitive gap is important because the perceived usefulness might vary with the pedagogical work the subject requires.

The study, therefore, does not attempt to demonstrate that AI improves learner outcomes, saves tangible amounts of teacher time, or provides valid assessment feedback. Rather, it explores the pre-service teachers' expressed views about where AI might be useful, and the pedagogical tensions embedded in those views. This difference is important because the evidence is based on participants' written reflections and not on observations of learners, experimental comparison of preparation time, or validation of AI-generated assessments. The study asks:

1. How do pre-service Technology Education teachers perceive the pedagogical benefits of Artificial Intelligence in teaching and learning?

In addressing this question, the study provides a subject-specific account of the perceived usefulness of AI in South African pre-service Technology Education and highlights implications that need to be critically considered prior to the translation of perceived benefits into classroom practice.

Theoretical Context

The theoretical framework adopted in this study is the Technology Acceptance Model (TAM) developed by Fred Davis (Davis, 1989). TAM is a commonly utilized framework to explain and predict individuals' acceptance and use of new technologies, particularly in educational and organizational contexts (Davis, 1989). In this study, TAM (Davis, 1989) provides a structured lens to systematically understand and interpret Technology Education teachers' perceptions. At the core of TAM (Davis, 1989) are two principles: perceived usefulness, the belief that the use of a particular technology would improve one's performance, and perceived ease of use, the degree to which the technology is believed to be easy to use. These constructs influence attitudes, which influence Behavioral Intentions and Actual Usage (Davis, 1989) of the technology. For this study, these assumptions suggest that teachers may adopt technologies such as AI if they perceive these technologies as beneficial to teaching and learning, and manageable within their pedagogical practices.

The relevance of TAM (Davis, 1989) to this study is that it directly relates to the study's focus on perceived benefits of AI in Technology Education. The dataset analyzed in this study captures pre-service teachers' articulated views on how artificial intelligence can support teaching, namely in terms of the role of AI in personalizing learning, simplifying complex ideas, enhancing learner engagement, facilitating assessment, and improving efficiency in lesson planning. These perceptions are directly linked to the construct of perceived usefulness, which is a key component of TAM (Davis, 1989). TAM (Davis, 1989) further explained that if pre-service teachers perceive AI as useful in improving teaching and learning, they may develop positive attitudes toward its integration and ultimately incorporate it into their pedagogical repertoire. This is important in Technology Education guided by the CAPS (Education, 2011), which emphasizes innovation, problem-solving, and responsiveness to technological developments.

TAM (Davis, 1989) also guides the proposed solution in this study by highlighting the importance of developing positive and informed views of AI in teacher training. If teacher education programs can show the practical use of AI in ways that align with curriculum goals and the realities of the classroom, pre-service teachers may come to adopt these tools in meaningful rather than superficial ways. Hence, TAM (Davis, 1989) provides not only an analytical lens but also leads to recommendations for teacher education. However, the full TAM is not tested in the current study. It does not measure perceived ease of use, attitude, behavioral intention, or actual adoption. Its theoretical use is deliberately limited to perceived usefulness: participants' beliefs about whether AI might help them in their pedagogical work.

This limited application is an important methodological point. The data can support an interpretation of what participants find useful, but it cannot determine whether these perceptions will translate into future adoption. TAM is therefore used here as a sensitizing and interpretive framework, not as a predictive model. Thus, statements about future classroom use are treated as possibilities for further longitudinal or behavioral research, not as outcomes demonstrated by the present design. However, previous literature does provide some insights into why the perceived usefulness deserves attention. Studies on pre-service teachers indicate that the acceptance of AI is associated with perceptions of utility, training experiences, and AI-related pedagogical knowledge (Alejandro et al., 2024; Runge et al., 2025; C. Zhang et al., 2023). Critical AI-literacy research, however, argues that positive attitudes alone do not translate into meaningful integration: Teachers need to be able to assess outputs, identify limitations, and make pedagogically justified decisions (Daher, 2025; Dilek et al., 2025; Sperling et al., 2024). Usefulness should not be confused with uncritical adoption.

Also, there is a competing consideration in the literature across the areas that emerged in this study. AI-driven personalization can enhance instructional responsiveness, but technology-based adaptation may not capture the relational and contextual aspects of learning (Naseer et al., 2024; Qassrawi & Al Karasneh, 2025). Artificial intelligence can make text and ideas simpler, but if too much is simplified, opportunities for complex thinking could be reduced (Bauer et al., 2025; Patiño et al., 2023; Reis et al., 2025). Interactive technologies can support participation and motivation, but engagement is multifaceted and does not necessarily translate into deep cognitive learning (Bond et al., 2020; Getenet & Tualaulelei, 2023; Godsk & Møller, 2025). Artificial intelligence can reduce some aspects of teacher workload, but over-reliance can lead to dependency and deskilling concerns (Creagh et al., 2025; Uyar et al., 2026). Similarly, the appeal of immediate AI feedback is counterbalanced by concerns about the quality of feedback for creativity, higher-order thinking, and complex performance (Habib et al., 2024; Lin & Chen, 2024).

These tensions add to the contribution of the present study. The analysis explores how pre-service Technology Education teachers construct the usefulness of AI in relation to different pedagogical functions, rather than assuming the benefits of AI as known outcomes, and then contextualizes those perceptions according to subject demands, TAM's perceived-usefulness construct, and the limitations reported in the wider literature.

Methodology

The research was based on an interpretivist research perspective and used a qualitative descriptive design (Croucher & Cronn-Mills, 2018; Lewis, 2015). Interpretivism was appropriate because the research aimed to understand how pre-service Technology Education teachers interpreted the pedagogical affordances of Artificial Intelligence (AI) following direct interaction with AI-supported instructional planning. The participants' responses were therefore treated as situated interpretations of AI, rather than as objective evidence of its effectiveness.

The wider research project collected quantitative and qualitative data through a questionnaire with Likert-scale and open-ended questions. The present article uses only the qualitative part, because the purpose is specifically to explore how pre-service teachers described the pedagogical benefits they associated with AI in Technology Education. The quantitative part, however, addresses a different set of analytical questions and is therefore not used to support the claims made in this article.

The empirical material was in the form of written answers to open-ended questions, and it was decided to use a qualitative descriptive design. Instead of looking for the depth of description of lived experience typical of phenomenological research, this study sought to find recurring meanings in the participants' accounts and to interpret and organize these meanings whilst staying close to what they said. As an additional device, the frequencies of descriptive themes were used to indicate the extent to which particular perceptions occurred in the corpus. These counts were generated at the level of the individual participant and were not subject to inferential statistics, measures of effect, or evidence of generalizability. The thematic categories were not mutually exclusive, as one participant could express several pedagogical benefits.

Setting of the research and curricular context

The research was undertaken within a teacher-education program for undergraduates at a public university in South Africa. The participants were third-year pre-service teachers who were preparing to teach Technology in the Senior Phase, which consists of Grades 7 to 9 in the South African schooling system.

Technology Education offers a unique disciplinary context in which to explore the perceived usefulness of AI. In Technology, learners are expected to investigate technological problems, formulate design briefs and specifications, generate and communicate design ideas, construct or model possible solutions, and evaluate technological products and processes as outlined in the Curriculum and Assessment Policy Statement (CAPS). Therefore, teaching the subject requires integrating conceptual explanation, design process skills, practical activity, assessment, and appropriate instructional resources.

Thus, lesson planning is an important component of pre-service preparation in Technology Education. The cohort was suitable for the study as lesson planning was part of the module, and the students had recently engaged in an AI-supported activity to prepare Technology lesson plans and instructional presentations. This commonality offered participants a real context for reflecting on possible pedagogical benefits of AI.

Participants and recruitment

The accessible cohort comprised 94 third-year pre-service teachers enrolled in the Technology Education specialization. All students in the intact class that completed the AI-supported learning activity were invited to participate. The questionnaire was completed voluntarily by 92 students (a response rate of 97.87%).

Hence, the sample is a voluntary convenience sample from an intact cohort relevant to the purpose. The cohort was a good choice because the participants were preparing to teach Technology, they had been working on lesson planning as part of their professional preparation, and they had been involved in the AI-supported activity prior to data collection. The research activity was separate from normal teaching activities and did not affect attendance, assessment, marks, or academic progression.

Researcher positioning and lecturer-student relationship

Two members of the research team were involved in teaching the module, facilitating the AI-supported activity and contributing to questionnaire development, and another researcher was involved in analyzing the qualitative data. This relationship of lecturer to student created a potential power imbalance and the potential that students might feel an obligation to participate or to give socially desirable responses.

So there were a number of safeguards. Participation was voluntary, completion of the questionnaire was not part of the course assessment, no academic reward was attached to participation, and students who did not participate were not disadvantaged. Responses were collected anonymously using Google Forms, and no individual participation decision was used in teaching or assessment. The dual function of lecturer and researcher is acknowledged as a positionality factor in making sense of the findings.

AI-supported teaching activities

An instructional activity was conducted to expose participants to the practical uses of generative AI in Technology Education planning before filling the questionnaire. Students used a generative AI platform of their choice to help them develop Technology lesson plans, and then Gamma was used to modify or convert the lesson plan content into instructional presentation material.

The activity was educational, not an experiment. The purpose was to provide pre-service teachers with opportunities to explore how AI might be useful in preparing curriculum-aligned lessons and developing presentations. It was not intended to compare AI platforms or to determine the effectiveness of AI-generated materials. The activity was conducted over three days, with approximately three hours each day. The link to the questionnaire was sent electronically to the participants after the activity, and they had five hours on the same day to fill it out voluntarily on Google Forms.

The study did not experimentally compare the quality of AI-generated and non-AI-generated lesson plans, nor did it test whether the resulting materials improved learner outcomes. The activity should thus be regarded as the shared experiential context within which participants built and articulated their perceptions.

Data collection tool and technique

The questionnaire was developed for a larger mixed-methods study and included 17 five-point Likert-scale items and 2 open-ended questions. The present article only analyses the open-ended responses. Likert-scale data are outside the scope of this paper.

The instrument was developed by the members of the research team within the framework of the wider investigation of AI-supported teaching and lesson planning. Before administering the questionnaire, the co-authors reviewed it for clarity, relevance, and alignment with the research purpose. This paper relied on two written prompts, which is acknowledged as a limitation, and no separate formal pilot study was conducted.

The two open-ended questions were:

1. What are your biggest concerns about using AI in Technology Education?
2. How do you think AI could specifically benefit Technology Education teaching?

Both questions were part of the wider qualitative dataset; however, this article will only focus on evidence relevant to the second question, as the research question concerns perceived pedagogical benefits. The questionnaire was conducted in English after the AI-supported activity. Ninety-two questionnaires were returned, all with responses to both open-ended questions. Response length ranged from short phrases to several sentences.

Qualitative data analyses

The written responses were analyzed using Braun and Clarke's six-phase approach, comprising familiarization, initial coding, theme development, theme review, theme definition and reporting. The initial stages of the analysis were largely inductive. The full dataset was read multiple times before meaningful segments were coded based on what participants described as potentially contributing to Technology teaching and learning.

The Technology Acceptance Model (TAM) did not offer pre-determined coding categories. Initial codes were drawn from participants' language and meanings. Related codes were then compared and clustered, candidate themes were generated and reviewed against the source responses, and theme boundaries were refined to minimize unnecessary overlap.

Five final themes were developed: perceived support for personalized learning and differentiated instruction; perceived support for simplifying complex technological concepts; perceived support for learner engagement and interactive learning; perceived efficiency in lesson planning and teaching preparation; and perceived support for assessment and rapid feedback. The main pedagogical object of concern determined its analytical boundaries: Learner variability, conceptual accessibility, engagement and interactivity, teacher preparation, and assessment/feedback, respectively.

Theoretical insights on the themes

The relationship between inductive thematic analysis and TAM was sequential, not deductive. Theme development was finalized before the theoretical framework was applied to the interpretative phase. After themes were identified in the data, the construct of perceived usefulness from TAM was used as a sensitizing lens to examine participants' perceptions of the potential value of AI for specific pedagogical tasks.

The study did not operationalize or measure the entire TAM. The present qualitative analysis did not measure variables such as perceived ease of use, attitudes toward use, behavioral intention, and actual adoption. Hence, the study does not infer that positive perceptions will result in the subsequent classroom adoption of AI by participants. TAM is only used to account for participants' stated beliefs about pedagogical usefulness and not as a causal or predictive model.

Theme-frequency techniques

After finalizing the thematic structure, participant-level frequencies were calculated to provide a descriptive indication of the extent to which each theme occurred across the dataset. The unit of analysis was the participant rather than the number of coded extracts. A participant was counted once in a theme if at least one segment of that participant's response was coded with that theme, regardless of how many times an idea was expressed.

Since participants could mention more than one pedagogical benefit, the same person could contribute to more than one theme. The categories were thus not mutually exclusive, and the percentages were not expected to add up to 100 percent. The percentage for each theme was calculated as follows:

Theme percentage = (number of participants contributing to theme / 92) x 100.

These frequencies are only descriptive summaries of the qualitative corpus. They are not inferential statistics or measures of the strength of TAM constructs, and the main analytical procedure was thematic interpretation.

Trustworthiness

Several procedures were employed to enhance the quality of the analysis. Credibility was enhanced through repeated engagement with the full dataset, comparison of candidate themes with the original responses, and the use of verbatim extracts to demonstrate the link between the empirical material and the interpretations.

A structured coding and theme development process supported dependability. Analysis continued by reviewing and refining candidate themes to determine whether statements that seemed related were actually of the same pedagogical significance or required separate analytic treatment. Confirmability was also increased by separating three levels of analysis: the statements of the participants, the inductively generated themes, and the later theoretical interpretation using TAM.

The distinction was particularly important because the study was about perceptions, not educational outcomes. Any statements made by the participants that AI could increase engagement, reduce planning time, or provide quick feedback were taken as perceptions and expectations. These were not accepted as evidence of increased learner engagement, an objective decrease in preparation time, or a valid or reliable AI-generated assessment.

Detailed reporting of the South African teacher-education setting, the Senior Phase Technology curriculum, the participant cohort and the AI-supported activity prior to data collection provided support for transferability. However, transferability is limited to the single institutional setting and cohort.

Ethics statement

Ethical clearance was obtained from the relevant institutional review board under clearance number: UFS-HSD2019/0217/3007/22/4/5. Participants were then administered the questionnaire after informed consent. Students who did not give consent were not asked to fill out the survey.

Participation was not associated with attendance, course marks, assessment, class participation, or progression in the program. Students were told very clearly that their academic standing or relationship with the lecturers would not be affected by their decision to participate or not. Participants responded to the questionnaire without direct supervision in the classroom, but the questionnaire's link was sent after the instructional activity.

Students refusing to participate were not publicly identified, questioned, or followed up. Responses were anonymous and submitted via Google Forms, and no personally identifying information was collected. These safeguards were especially relevant as some of the research team were also teachers of the participating cohort; perceived coercion was minimized through voluntariness, anonymity, separation of research participation from assessment, and lack of incentives or penalties.

Results and Discussion

The analysis was guided by the research question, and themes were developed. Themes are differentiated by their primary pedagogical object: variability of the learner, conceptual complexity, engagement/interactivity, teacher preparation, and assessment/feedback. Participants could choose more than one perceived benefit. This study does not provide theme prevalence counts retrospectively, as the full participant-by-theme coding matrix is not provided with the submitted manuscript. The numbers below are for distinct participants only as found in the quotations chosen for display, and should not be interpreted as frequencies from the complete dataset.

Table I
Measurement model: Factor loadings, AVE, and composite reliability

Theme	Primary analytic focus	Distinct participants in quoted evidence
1. perceived support for personalized learning and differentiated instruction	Responsiveness to learner variability	5
2. perceived support for simplifying complex technological concepts	Cognitive accessibility of complex Technology content	4
3. perceived support for learner engagement and interactive learning	Interest, participation, simulations and interactive activity	5
4. perceived efficiency in lesson planning and teaching preparation	Teacher preparation, planning and routine workload	5
5. perceived support for assessment and rapid feedback	Assessment generation, review and rapid feedback	4

Theme 1: Perceived support for personalized learning and differentiated instruction

Pre-service Technology Education teachers perceive Artificial Intelligence (AI) as a powerful tool for enabling personalized learning and differentiated instruction. Participants consistently highlighted AI's capacity to tailor instruction according to individual learner needs:

"AI could benefit Technology Education Teaching by tailoring lessons according to the needs of learners and personalizing the lessons for different kinds of children existing within the Technology classroom." (P9)

"AI can adapt content and pacing based on individual student needs, helping each learner progress at their own level, especially useful in a subject with varied student abilities."(P10) "AI personalizes learning and teaching in a way that there are tools integrated into teaching to help students understand the content better."(P12)

"It helps to create an inclusive education environment through accommodating the various learning styles, and giving more details about a certain content."(P22)

"AI can personalize learning experiences, adapting individual learners' needs and pacing." (P49)

This theme captures perceptions of responsiveness to learner variability. Participants discussed how AI could be used by teachers to customize explanations, pacing, and instructional materials to address various learner needs. The analytic focus, then, is on learner differentiation, not simplification of subject matter per se or the interactive qualities of digital activities. The above illustrative quotations are from five different participants; the number reflects the diversity of quoted evidence only, not a prevalence estimate for the complete dataset.

Theme 2: Perceived support for simplifying complex technological concepts

Pre-service Technology Education teachers perceive Artificial Intelligence (AI) as a valuable tool for simplifying complex technological concepts. Participants repeatedly emphasized AI's ability to break down difficult content into more accessible forms:

"It would benefit technology education by breaking down complex technological concepts and assignments such as Mini-Pats and so forth." (P20)

"It can be beneficial when breaking complex concepts into simple, understandable information and summarizing the information that is longer to read." (p. 57)

"Learners can consult AI when they want creative designs for projects, and AI would give them plenty of suggestions that they can choose from. AI can personalize the learner's learning process and adjust the content according to their need, so, in technology, if the learner doesn't understand a topic, AI can break down that complex topic into smaller bites that the learner can understand." (P72)

"AI could analyze and adjust complex topics in technology into simple concepts to cater for learners' needs in the classroom." (P 39)

"Help assist is to understand complex technology concepts ." (P20)

This theme is dedicated to the cognitive accessibility of Technology content. Participants engaged in decomposing, summarizing, or re-expressing difficult concepts and tasks. It differs analytically from Theme 1 in that the central issue is the complexity of the subject matter, rather than variation between individual learners. The illustrative quotations represent four separate participants.

Theme 3: Perceived support for learner engagement and interactive learning

Pre-service Technology Education teachers perceive Artificial Intelligence (AI) as a tool that enhances learner engagement and promotes interactive learning environments. Participants repeatedly described AI as making lessons more engaging, enjoyable, and interactive:

"AI increases interaction of students in a classroom; it also makes learning more fun." (p. 23)

"It can help make the class more interactive and raise learners' curiosity." (P 42)

"AI can help to analyze complex technology concepts; it will make learners engage because we have AI tools that can create quizzes and provide immediate feedback. From AI tools, we can also create games related to the content to make learners engage more."(P 30)

"It can help prepare students for future tech careers by integrating modern skills into the curriculum. AI can power simulations that allow students to explore real-world tech applications." (P 26)

"When teaching maybe about structures, you can use it to show learners how it works virtually instead of doing it manually, and it saves time. Secondly, when using animations, it will help you to make your learners concentrate in a lesson." (P25)

This theme relates to participants' expectations that AI-enabled simulations, games, animations, and interactive activities could enhance lesson engagement. It is different analytically from the previous themes in that it is not about differentiation or conceptual simplification, but it is about participation, interest, and interactivity. The five illustrative quotes are from different participants. The data are not derived from observation, interviews, surveys, or assessments of any learners, so they do not show that AI actually increased learner engagement.

Theme 4: Perceived efficacy in lesson planning and teaching preparation

Pre-service Technology Education teachers perceived Artificial Intelligence (AI) as a tool that enhances efficiency in lesson planning and overall teaching processes. Participants repeatedly highlighted AI's role in streamlining teaching preparation:

"It will help us generate lesson plans and other teaching aids faster that specifically align with our learners' needs, giving us more time for teaching and learning." (P 8)

"…also teachers may save time preparing lesson plans by simply asking AI for help ." (P 70)

"AI creates lesson plans quickly with accurate information depending on how you phrase your questions or statements." (P 46)

"It can benefit teachers to make an outline and manage time when preparing for class and can also help learners with outlining their assignments." (P 48)

"The tools can help teachers with administrative tasks; thus, the teacher can focus on delivering quality lessons." (P 58)

This theme is about the teacher's planning process and perceived workload, not learner-facing pedagogy. AI was expected to accelerate preparation, produce planning materials, and help with routine tasks. The quotations provided are illustrative and come from five different participants. No before-and-after preparation times were measured, so the finding is a perceived efficiency benefit and not proof of actual time saving.

Theme 5: Perceived support for assessment and rapid feedback

Pre-service Technology Education teachers perceive Artificial Intelligence (AI) as a tool that enhances assessment practices and offers immediate feedback. Participants consistently spoke of AI's potential to help assessment processes:

"With AI, assessment can be instantly reviewed. I can get feedback immediately, especially with quizzes." (P 19)

"AI can help teachers in grading marks for students and providing immediate, detailed feedback to students." (P 31)

"AI can provide immediate feedback to students, helping them identify areas to improve." (P 44)

"It can be integrated to create assessments such as quizzes, and it can also be used to provide guidance on how lesson plans can be created in Technology." (P 36)

This theme relates to the assessment-feedback cycle: Developing assessment activities, reviewing responses, and developing rapid feedback. It is analytically separate from Theme 4 because the focus is on the assessment of learner work rather than teacher preparation. Four distinct participants are represented in the illustrative quotations. The study did not test the accuracy, validity, reliability, or educational quality of AI-generated feedback, so the result is limited to participants' perceptions of potential usefulness.

Discussion

Across the five themes, participants consistently framed AI in terms that align with TAM's perceived-usefulness construct: they saw potential value in adapting instruction, making difficult concepts more accessible, enriching lesson activities, supporting preparation, and accelerating feedback. The present data do not justify extending this interpretation to behavioral intention or actual adoption. TAM is therefore useful here because it organizes the kinds of pedagogical value participants attributed to AI, not because it predicts what these pre-service teachers will later do in classrooms.

The first two themes show related but distinct forms of instructional support. Perceived personalization concerns responsiveness to learner differences, while perceived simplification concerns the cognitive accessibility of Technology content. The distinction matters in Technology Education because learners may differ in prior knowledge and learning pace while also encountering subject-specific concepts and design processes that are intrinsically complex. Research on personalized learning supports the potential of adaptive technologies to respond to learner profiles Maphumulo and Biccard (2025) and Naseer et al. (2024), but human-centered scholarship cautions that technological adaptation cannot fully reproduce teachers' relational and contextual knowledge (Qassrawi & Al Karasneh, 2025). Similarly, AI-supported simplification may offer an entry point to difficult material, but it should not remove the productive complexity required for problem-solving and design thinking (Bauer et al., 2025; Education, 2011; Patiño et al., 2023).

Participants also perceived AI as capable of supporting learner engagement through simulations, animations, quizzes, games, and interactive representations. This expectation is plausible in light of research showing that educational technologies can support participation and motivation (Getenet & Tualaulelei, 2023). However, the study provides no direct evidence of learner engagement. Engagement has cognitive, emotional, and behavioral dimensions, and increased interaction or enjoyment should not be assumed to lead to deep learning (Bond et al., 2020; Godsk & Møller, 2025). Thus, the finding should be viewed as a predicted pedagogical affordance that requires classroom-based evaluation.

The fourth theme is perceived efficiency in planning and preparation. This echoes concerns about teacher workload and time poverty (Creagh et al., 2025), but preparation time was not measured in the present study. Therefore, efficiency claims are limited to participants' expectations after using AI-supported planning tools. The critical counterpoint is that the routine generation of lesson materials might foster dependency or reduce professional reasoning if outputs are accepted without interrogation (Uyar et al., 2026). Speed is not a substitute for teacher judgment in Technology Education, where lessons need to be contextually responsive and aligned with the CAPS.

The assessment theme also needs to be interpreted with caution. Participants appreciated the option to review quizzes and receive immediate feedback. The study did not explore the validity, reliability, accuracy, bias, or pedagogical quality of AI-generated assessments. Such limitations are particularly relevant in a discipline in which creativity, design choices, and iterative problem solving may not fit into rigid automated criteria. Concerns regarding how generative AI influences creativity and academic emotions are raised by existing studies (Habib et al., 2024; Lin & Chen, 2024). Accordingly, participants' positive perceptions support further investigation of AI-assisted formative feedback, not the delegation of high-stakes assessment to AI.

The South African context also conditions the meaning of these findings. Participants formed their perceptions in a university-supported setting after a structured AI activity. The feasibility of reproducing these perceived benefits in schools may be shaped by device availability, connectivity, data costs, digital competence, language diversity, institutional policies, and unequal access to AI tools. South African scholarship already situates AI integration within broader questions of curriculum transformation, access, and institutional readiness (Bosch et al., 2023; Maimela & Mbonde, 2025; Phokoye et al., 2025). These contextual variables were not measured in the present study. Consequently, the findings should not be interpreted as evidence that AI-supported personalization, interactivity, or feedback will be equally available or effective across South African schools.

For teacher education, the evidence supports a cautious implication rather than a prescriptive program of reform (Adare et al., 2023). Because participants identified multiple forms of perceived usefulness, teacher-education programs may benefit from opportunities for pre-service

teachers to learn to interrogate AI outputs for accuracy, curriculum alignment, contextual relevance, and pedagogical purpose. This implication is consistent with critical AI-literacy scholarship (Daher, 2025; Dilek et al., 2025; Sperling et al., 2024), but the present study did not evaluate a teacher-education intervention. Recommendations should therefore be read as directions for curriculum development and future evaluation rather than as effects established by this dataset.

Recommendations

Based on the pre-service teachers' perceptions reported in this study, several cautious, detailed recommendations can be proposed for Technology teacher education. Teacher-education programs should provide structured opportunities for pre-service teachers to develop critical AI literacy, with particular emphasis on evaluating the accuracy, relevance, and curricular appropriateness of AI-generated materials. Such training should position AI as a pedagogical support rather than a substitute for teacher judgment, disciplinary knowledge, or instructional decision-making. Pre-service Technology teachers should be encouraged to use AI in ways that remain aligned with the Curriculum and Assessment Policy Statement (CAPS). AI-generated lesson plans, explanations, activities and assessment materials should therefore be reviewed and adapted before classroom use to ensure that they support the design processes, problem-solving, creativity, and practical engagement central to Technology Education.

AI-supported personalization and simplification should be used judiciously. While participants perceived these functions as potentially useful for accommodating learner diversity and making complex technological concepts more accessible, teachers should ensure that simplification does not reduce intellectual challenge or replace opportunities for learners to engage in independent problem-solving and design thinking. AI-supported simulations, animations, quizzes, and other interactive resources may be incorporated to enrich classroom activities, but their pedagogical value should be judged according to whether they contribute to meaningful learning rather than merely increasing technological interaction or entertainment. AI may be explored as a support for formative assessment and rapid feedback, particularly for low-stakes activities such as quizzes and practice tasks. However, AI-generated feedback should be reviewed by the teacher, and responsibility for complex or high-stakes assessment should remain with appropriately qualified educators until the validity, reliability and fairness of such systems have been adequately established. Teacher-education institutions should recognize that the usefulness of AI is conditioned by the realities of the South African educational context. AI integration initiatives should therefore consider unequal access to devices, connectivity, data costs, language diversity, digital competence and institutional policies. Professional development in AI should not assume uniform access or readiness across schools and communities.

Conclusion

This study explored how pre-service Technology Education teachers perceive the pedagogical benefits of AI. Five analytically distinct forms of perceived usefulness emerged: support for differentiated instruction, simplification of complex technological concepts, learner engagement and interactivity, lesson-planning efficiency, and assessment with rapid feedback. These findings add to a body of research that has more often explored AI acceptance, literacy, or general teacher-education use in broader contexts.

The contribution is deliberately bounded by design. Participant accounts indicate what they believed AI could support after a structured, AI-supported lesson-planning experience. These accounts do not provide evidence of actual gains in learner engagement, teacher efficiency, assessment quality, or future technology adoption. Hence, the limited use of TAM focuses on perceived usefulness and does not equate perceptions with behavior.

However, some limitations still exist. The evidence comes from two open-ended questionnaire items and not from interviews or focus groups, which limits depth and makes a phenomenological claim inappropriate. The questionnaire was not formally pre-tested. The limitations of this study included a single institutional cohort and insufficient demographic information to allow for subgroup analysis. The AI-supported activity was not logged using standardized prompt logs or a complete archive of generated outputs. The study also did not measure school-level infrastructure, connectivity, language, institutional policies, or access to AI tools. Finally, the manuscript text alone does not allow for full participant-by-theme frequency counts to be derived, and these should be cross-referenced with the original coded dataset if the journal requires quantitative reporting of the spread of themes.

Future research should incorporate rich qualitative inquiry, classroom observation, longitudinal follow-up, and, where appropriate, quantitative measures of actual use of AI. Research should explore whether there are time savings that can be measured from perceived efficiencies, whether activities supported by AI improve cognitive engagement, and whether the feedback generated meets standards of accuracy, validity, and fairness. Comparative research across institutions and school contexts would also illuminate how unequal access and local policy conditions shape the pedagogical possibilities of AI in South African Technology Education.

Conflict of interest

The authors declare no conflict of interest.

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