

DIGITAL COGNITION AND EPISTEMIC BELIEFS: HOW PRE-SERVICE PRIMARY TEACHERS CONSTRUCT MATHEMATICAL KNOWLEDGE

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ABSTRACT

The increasing integration of digital technology in teacher education has reshaped how future teachers engage with knowledge and learning. This study explores how pre-service primary mathematics teachers conceptualize knowledge within digital learning environments and examines the relationship between their epistemic beliefs and digital engagement. A quantitative descriptive design was employed involving 34 undergraduate students enrolled in a primary teacher education program at an Indonesian university. Data were collected using a 20-item questionnaire adapted from Schommer's Epistemological Beliefs framework and contextualized to reflect digital learning experiences. The instrument measured beliefs concerning the certainty, simplicity, and source of knowledge, as well as perceptions of learning ability and learning processes. Responses were analyzed using descriptive statistics. The findings indicate that participants predominantly hold constructivist-oriented epistemic beliefs, viewing knowledge as interconnected, evolving, and shaped through reflection and experience. Digital technology was generally perceived not merely as an instructional aid but as a medium that supports pedagogical thinking and professional growth. Statements reflecting growth-oriented learning and independent knowledge construction received strong agreement, whereas fixed and authority-dependent beliefs were largely rejected. These results suggest that epistemic sophistication may support more reflective and meaningful digital engagement. The study highlights the importance of integrating epistemological development with digital competence in teacher education to foster adaptive and reflective future educators.

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INTRODUCTION

In the ever-evolving landscape of 21st-century education, digital technology is no longer a complementary tool but is reshaping the very nature of teaching and learning, particularly in terms of cognition. Digital cognition refers to thinking skills influenced by digital technology,

such as how prospective elementary school mathematics teachers process information, visualize mathematical concepts, and utilize applications, simulations, or digital platforms to understand and deliver material. Digital pedagogy, characterized by the integration of technology into educational design and delivery, has become a crucial component of teacher preparation programs worldwide. Epistemic beliefs are an individual's beliefs about the nature of knowledge, such as whether it is considered fixed or changing, fragmented or integrated, and how knowledge is acquired and validated. These two aspects play a crucial role in the process of knowledge construction, how an individual organizes and develops meaningful understanding, particularly in the context of elementary school mathematics teacher education.

The integration of digital technology into education has not only changed instructional practices but has also reshaped how knowledge is understood and constructed. For pre-service primary mathematics teachers, digital environments are more than platforms for delivering content. They influence how mathematical ideas are interpreted, connected, and communicated. As a result, digital engagement increasingly becomes part of teachers' cognitive processes. At the core of this transformation lies the concept of epistemic beliefs, which refer to individuals' assumptions about the nature of knowledge and the process of knowing (Hofer & Pintrich, 1997). Some individuals perceive knowledge as certain and transmitted by authority, while others regard it as evolving, contextual, and constructed through inquiry. These beliefs subtly shape how future teachers evaluate information, respond to technological change, and design learning experiences.

While teacher education programs have widely incorporated digital competence frameworks, the epistemological dimension of digital engagement remains comparatively underexamined. Research has demonstrated that teachers' beliefs influence how technology is interpreted and enacted in classrooms (Demirbag & Bahcivan, 2021a). However, less attention has been given to how epistemic orientations and digital cognitive engagement interact specifically within primary mathematics teacher preparation.

For future educators, especially those still in their early years, the digital shift can present both unprecedented opportunities and complex challenges. The availability of digital platforms, learning simulations, and interactive learning environments provides access to a wide variety of instructional resources and pedagogical models (Nyarai Tunjera, 2019). This demands a critical rethinking of how knowledge is constructed, evaluated, and applied in authentic educational environments. At the heart of this shift in knowledge construction lies the concept of epistemic beliefs, which are individual beliefs about the nature of knowledge and the process of knowing (Muis et al., 2021).

Epistemic beliefs profoundly shape how pre-service teachers interpret content, interact with students, and adopt or reject digital innovations in pedagogy (Kong & Lin, 2022; Lee, 2018). For example, a teacher who believes that knowledge is fixed and absolute may struggle to interact with the fluid, constructivist nature of digital learning environments. In contrast, teachers who have a more sophisticated epistemic perspective, who recognize that knowledge is evolving, contextual, and socially constructed, are in a better position to adapt their teaching practices to technological change (Hofer & Pintrich, 1997).

Despite growing interest in digital literacy and technology integration in teacher education, the relationship between digital cognitive frameworks and epistemic beliefs remains underexplored. Studies have shown that epistemic beliefs influence not only how pre-service teachers interact with content but also how teachers perceive their agency and self-efficacy in digital teaching contexts (Demirbag & Bahcivan, 2021b). Pre-service teachers' beliefs about the certainty of their knowledge and their perceived ability to critically evaluate digital information play a crucial role in determining whether they adopt reflective, learner-centered digital

pedagogy (Xiong et al., 2022). Recent research emphasizes the importance of addressing epistemological development alongside digital competencies in teacher preparation programs (Ata & Alpaslan, 2024). This study aims to examine how pre-service elementary mathematics teachers conceptualize knowledge in digital learning environments and how their epistemic beliefs intersect with their engagement with digital cognitive frameworks.

METHOD

This research was conducted using a quantitative descriptive approach to examine patterns in epistemic beliefs and digital engagement among pre-service teachers. Rather than testing causal relationships, the study aimed to capture how participants currently conceptualize knowledge and learning within digital contexts (Fraenkel et al., 2012). The participants were 34 undergraduate students enrolled in a primary mathematics teacher education program at an Indonesian university. Most of them were in the advanced stage of their studies and had completed coursework related to pedagogy and educational technology. Participants were recruited based on accessibility and relevance to the research focus. Their involvement was voluntary, and prior to completing the questionnaire, they were informed about the purpose of the study and assured that their responses would remain anonymous.

Data were collected through a structured questionnaire consisting of 20 statements. The instrument was adapted from Schommer's Epistemological Beliefs framework and adjusted to reflect digital learning environments, particularly the role of technology in shaping understanding and teaching perspectives. Each item was rated on a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. The items represented five epistemic dimensions: certainty of knowledge, simplicity of knowledge, source of knowledge, speed of learning, and beliefs about ability.

The questionnaire was distributed online using Google Forms to ensure ease of access and consistent response recording. To avoid ambiguity, all items were presented in Bahasa Indonesia. At the end of the survey, two optional open-ended questions were included to allow participants to elaborate on their views, although the present analysis focuses on the quantitative responses. The data were analyzed descriptively. Mean scores and response distributions were calculated for each item to identify general trends across epistemic dimensions. To provide a clearer overview of response patterns, the results were also presented in graphical form using stacked bar visualizations. The analysis was intended to describe tendencies within the group rather than to establish statistical correlations.

RESULTS AND DISCUSSION

Results

This study gathered responses from 34 pre-service education teachers to explore their epistemic beliefs and their attitudes toward the integration of digital technologies in teacher education. The survey consisted of 20 Likert-scale statements, each aimed at measuring perceptions related to knowledge construction, teaching development, and digital pedagogy. The Likert responses ranged from "Strongly Disagree" to "Strongly Agree." A descriptive analysis of the data indicates a general trend toward agreement across most statements.

Figure 1 shows that the majority of prospective elementary school mathematics teachers have a constructive view of knowledge and the learning process, particularly in the context of elementary school mathematics teacher education, which is increasingly linked to the use of digital technology. The statement with the highest mean score, "I believe that all courses in teacher education support a unified understanding," reflects a strong belief that the teacher education curriculum is viewed as a complementary whole, rather than as separate components.

This belief aligns with other findings, such as the statements "The knowledge I learn in teacher education is interconnected" and "I feel that understanding effective teaching will keep evolving," which indicate that prospective elementary school mathematics teachers view knowledge as developing and interconnected, influenced by experience and time. Prospective elementary school mathematics teachers also demonstrated a relatively open attitude toward the use of technology in learning. They view technology not simply as a tool, but as a reflective tool that influences their thinking about teaching practice. This is reflected in the high scores on statements such as "Information from digital platforms often updates my views on teaching" and "Digital technology has made me realize that educational knowledge can change over time." Furthermore, the high level of agreement with the statement "I believe I must construct my own understanding, not just follow instructions" indicates that prospective elementary school mathematics teachers value independent and active learning, rather than simply following instructions.

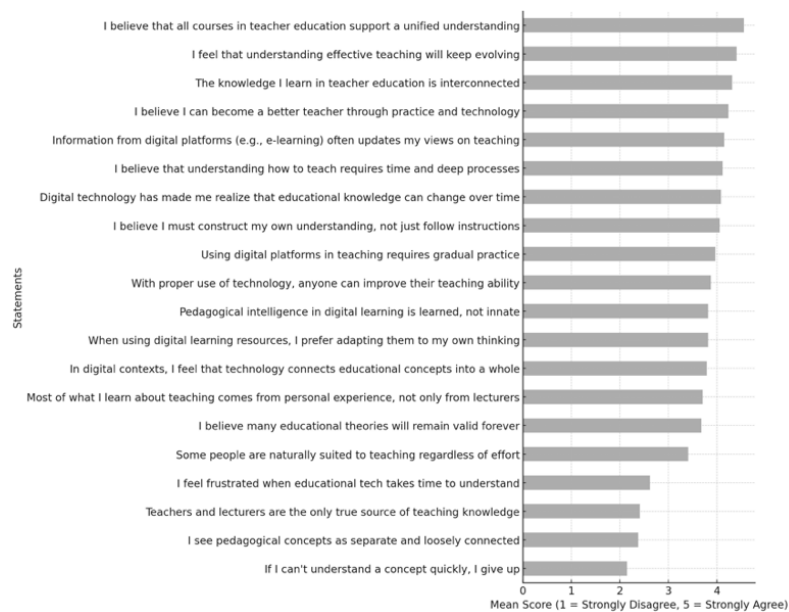


Figure 1. Statement's Mean of Pre-Service Teachers' Responses

Several statements reflecting a fixed mindset or passive attitude toward learning received relatively low scores. For example, "If I can't understand a concept quickly, I give up" was the statement with the lowest score, indicating that the majority of prospective elementary school mathematics teachers do not give up easily when faced with difficulties. Similarly, the statement "Teachers and lecturers are the only true source of teaching knowledge" showed a low level of agreement, indicating that prospective elementary school mathematics teachers do not rely on a single authority to acquire knowledge, but rather prefer a collaborative and reflective approach. The response pattern seen in the graph reflects an open and progressive learning orientation. The prospective elementary school mathematics teachers demonstrated a tendency to continuously learn, be reflective, and adapt to the dynamics of digital learning. Their view of knowledge is not rigid, but rather flexible and process-oriented. These findings indicate that the more complex and mature the epistemic beliefs held, the greater the likelihood that they will be actively involved in the use of technology and adopt teaching strategies that are appropriate to the needs of the times.

Table 1 displays the results of data processing in a table of mean statement scores, revealing several interesting tendencies among prospective elementary school mathematics teachers in their understanding of learning, knowledge, and the use of technology. Several statements received very high scores, above 4.00, indicating a strong level of agreement. One such

statement is "I believe that all courses in teacher education support a holistic understanding," with the highest score of 4.56. This indicates that the majority of prospective elementary school mathematics teachers view the teacher education curriculum as structured and complementary, rather than as separate components.

Table 1. Mean of Each Statements

Statement	Mean
I believe that all courses in teacher education support a unified understanding	4.56
I feel that understanding effective teaching will keep evolving	4.41
The knowledge I learn in teacher education is interconnected	4.32
I believe I can become a better teacher through practice and technology	4.24
Information from digital platforms (e.g., e-learning) often updates my views on teaching	4.15
I believe that understanding how to teach requires time and deep processes	4.12
Digital technology has made me realize that educational knowledge can change over time	4.09
I believe I must construct my own understanding, not just follow instructions	4.06
Using digital platforms in teaching requires gradual practice	3.97
With proper use of technology, anyone can improve their teaching ability	3.88
Pedagogical intelligence in digital learning is learned, not innate	3.82
When using digital learning resources, I prefer adapting them to my own thinking	3.82
In digital contexts, I feel that technology connects educational concepts into a whole	3.79
Most of what I learn about teaching comes from personal experience, not only from lectures	3.71
I believe many educational theories will remain valid forever	3.68
Some people are naturally suited to teaching regardless of effort	3.41
I feel frustrated when educational technology takes time to understand	2.62
Teachers and Lecturers are the only true source of teaching knowledge	2.41
I see pedagogical concepts as separate and loosely connected	2.38
If I can't understand a concept quickly, I give up	2.15

Other statements with high scores include "I feel that my understanding of effective teaching will continue to develop" (mean: 4.41) and "The knowledge I learn in teacher education classes is interconnected" (mean: 4.32). These two statements reinforce the idea that prospective elementary school mathematics teachers do not view knowledge as final, but rather as an ongoing and interconnected process. This strongly indicates that they hold constructivist epistemic beliefs. Furthermore, high scores were also found on items related to reflection through digital platforms, the use of technology to update perspectives on teaching, and the importance of gradual practice in understanding learning technology. These findings indicate that prospective elementary school mathematics teachers generally demonstrate digital readiness and an awareness of the importance of reflection in the learning process.

Several statements fell into the medium score category, with mean scores ranging from 3.5 to 3.9. For example, the statement "Most of what I learn about teaching comes from my own experience, not just from lecturers" received a score of 3.71, while the statement "Some people are naturally cut out to be teachers" received a score of 3.41. Both indicate a diversity of views among prospective elementary school mathematics teachers. On the one hand, they value personal experience as a learning resource, but on the other hand, some still believe in natural talent for teaching. This reflects that despite the strong dominance of constructive views, some traditional beliefs still persist in the minds of a small number of prospective elementary school mathematics teachers.

The statements with the lowest scores were below 3.0. One of these was "I feel frustrated when it takes a long time to understand new educational technology," with a score of 2.62. This low score indicates that the majority of prospective elementary school mathematics teachers do not feel frustrated when faced with challenges in learning new technology, indicating they are quite resilient to obstacles and willing to adapt. Other statements, such as "Teachers and lecturers are the only true source of good teaching methods" (2.41) and "If I can't understand a concept within a few minutes, I give up" (2.15), also received low scores. This indicates a rejection of a mindset that relies on a single authority or that gives up when faced with difficulties. The majority of prospective elementary school mathematics teachers appeared to demonstrate perseverance and a tendency to construct understanding independently.

The highest mean score ($M = 4.56$) corresponded to the perception that teacher education courses contribute to a coherent and unified understanding. This suggests that participants perceive their academic preparation not as fragmented subjects, but as mutually reinforcing components of professional growth. Similarly, strong agreement with statements emphasizing the evolving nature of teaching knowledge indicates recognition that pedagogical understanding is dynamic rather than fixed.

In relation to digital engagement, participants demonstrated a reflective orientation. Many acknowledged that digital platforms frequently reshape their perspectives on teaching and broaden their conceptual understanding. This pattern implies that technology is interpreted not merely as a functional instrument but as an intellectual resource. Conversely, statements representing fixed epistemological positions received comparatively low agreement. The idea that one should abandon effort if a concept is not immediately understood yielded one of the lowest mean scores. Likewise, reliance on lecturers as the sole legitimate source of knowledge was largely rejected. These trends indicate resilience and a tendency toward autonomous meaning-making.

These findings indicate that prospective elementary school mathematics teachers tend to demonstrate a reflective and relatively mature understanding of the teaching and learning process. Several key points can be drawn from the results:

- Knowledge as a developing process.
Participants generally view knowledge as something that evolves over time rather than as a fixed set of facts. They recognize that understanding can grow through experience, interaction, and reflection during the learning process.
- Positive orientation toward educational technology.

The results suggest that most prospective teachers hold favorable attitudes toward the use of technology in learning. Technology is not seen as a source of difficulty or resistance, but rather as a tool that can support and enrich instructional practices.

- Shift away from authority-centered views of knowledge.

Many participants appear to question the traditional belief that lecturers are the sole source of truth in the classroom. Instead, learning is understood as a more interactive and collaborative process.

- Teaching as a developable professional competence.

The findings also show that participants tend to reject the idea that only certain individuals are naturally suited to become teachers. Instead, teaching ability is perceived as something that can be developed through effort, experience, and continuous engagement in the profession.

- Learning and teaching as dynamic processes.

Prospective teachers tend to see both learning and teaching as processes that evolve through practice, reflection, and participation, which is essential for the development of reflective and adaptive educators.

Discussions

Pre-service teachers articulate their beliefs about knowledge in the context of digital learning

Based on the average scores on items representing epistemic beliefs, it was found that prospective teachers tended to have a fairly progressive view of knowledge. Statements such as "I believe that all courses in teacher education support a unified understanding" and "The knowledge I learn in teacher education classes is interconnected" received high average scores of 4.56 and 4.32, respectively. This indicates that prospective elementary school mathematics teachers view knowledge as interconnected and inseparable. However, several statements indicating a more rigid or traditional view, such as "Teachers and lecturers are the only true source of good teaching methods," received low scores (average 2.41), indicating that the majority of prospective elementary school mathematics teachers disagree with this view. Overall, the average score for this theme was 3.59, indicating the dominance of constructivist views in the context of digital learning, although there is still slight variation among individuals. In the context of digital education, such beliefs become particularly relevant. Digital learning environments are often open-ended, non-linear, and require the ability to navigate information from multiple sources. When individuals perceive knowledge as flexible and changeable, they are more likely to adapt to the complexities of digital learning. This aligns with the findings of Koçoğlu (2009) who stated that developed epistemic beliefs support the acceptance of technology as part of pedagogical practice.

The types of digital cognitive frameworks that pre-service teachers engage with during their training are closely linked to their underlying epistemic beliefs

Prospective elementary school mathematics teachers expressed a high appreciation for the use of digital technology as a tool that unifies and enriches their understanding. Statements such as "Digital technology makes me realize that knowledge in education can change over time" (mean 4.09) and "Information from digital platforms often updates my views on teaching" (mean 4.15) demonstrate how technology plays a role in shaping their pedagogical frameworks. One interesting finding is that prospective elementary school mathematics teachers view technology not only as a tool but also as part of the thinking process itself. Scores for statements such as "When I use digital learning resources, I prefer to adapt them to my own way of thinking" (mean 3.82) support this. The average score for this theme was 3.96, higher than the other two, indicating a strong link between constructivist epistemic beliefs and the reflective and active use of digital frameworks. As noted by Kirschner et. al. (2018) technology adoption in

education is not simply a matter of the availability of tools, but also about how teachers understand the learning process itself.

The relationship between the sophistication of pre-service teachers' epistemic beliefs and the depth of their engagement with digital tools and pedagogical strategies.

Although this study was descriptive in nature and did not use inferential correlation tests, data patterns suggest a link between more mature epistemic beliefs and deeper digital engagement. Statements such as "I believe I can become a better teacher through practice and the use of technology" (mean 4.24) and "Understanding teaching requires time and a deep process" (mean 4.12) indicate an acknowledgment of the gradual learning process, a hallmark of reflective epistemology. Statements reflecting a fixed mindset, such as "If I can't understand a concept within a few minutes, I give up," received a very low mean score (2.15), indicating that most elementary school mathematics teacher candidates disagree with an instantaneous learning approach. With an overall mean for this theme of 3.62, it appears that the more complex beliefs about knowledge and learning, the deeper the elementary mathematics teacher candidates' engagement with technology and digital-based pedagogical strategies.

The findings of this study underscore the importance of epistemic positions in shaping how elementary school teacher candidates interact with educational technology. Prospective elementary school mathematics teachers view knowledge not only as fixed and given, but as something that grows and is actively constructed through experience and interactions with materials, instructors, and digital media. This view is consistent with constructivist approaches to education, which emphasize that meaningful learning occurs when individuals construct their own understanding through active engagement (Kosse et al., 2022). One noteworthy aspect is how prospective elementary school mathematics teachers tend to view technology not as an end in itself, but as a medium for thinking, exploring, and constructing understanding. This is reflected in high scores on statements indicating a tendency to adapt digital resources to personal ways of thinking, as well as an openness to changing perspectives through exposure to digital content. In other words, digital tools are used not only to convey information, but also as a bridge between ideas and practice.

The link between epistemic beliefs and digital engagement is also evident in how prospective elementary school mathematics teachers respond to statements related to patience and the process of learning technology (Hofer & Pintrich, 1997). Those who understand that learning takes time and effort are more positive about the use of technology. Conversely, negative responses to the idea that one must quickly grasp concepts or be unsuitable to be a teacher without effort demonstrate a rejection of a fixed mindset. This finding reinforces the view that technological mastery does not stand alone but is closely linked to a deeper understanding of the teaching and learning process (Merk et al., 2017).

Interpretation through Schommer's Epistemological Beliefs Framework

The findings of this study can be meaningfully interpreted through Schommer's Epistemological Beliefs framework, which conceptualizes epistemic beliefs as multidimensional rather than unidimensional. According to Schommer, individuals hold beliefs concerning the certainty and simplicity of knowledge, the source of knowledge, the speed of learning, and the nature of ability. The response patterns observed in this study indicate a tendency toward relatively sophisticated orientations across these dimensions (Blumberga & Vorobjovs, 2015). First, with regard to the certainty of knowledge, participants demonstrated strong agreement with statements emphasizing that knowledge evolves and develops over time. High mean scores for items such as the interconnectedness of courses and the evolving nature of effective teaching suggest that knowledge is not perceived as fixed or absolute. Within digital learning environments, where information is continuously updated and recontextualized this

flexible epistemic stance becomes particularly adaptive. Participants' acknowledgment that digital platforms reshape their perspectives reflects an understanding of knowledge as tentative and context-sensitive (Nielsen, 2012).

Second, in relation to the simplicity of knowledge, the high agreement with statements emphasizing conceptual integration indicates that participants do not perceive knowledge as a collection of isolated facts. Instead, they recognize relationships across courses and experiences. This aligns with Schommer's notion that sophisticated epistemic beliefs involve viewing knowledge as complex, structured, and interrelated rather than fragmented (Guo et al., 2025). Third, the relatively low agreement with statements positioning lecturers as the sole source of teaching knowledge reflects development in the source of knowledge dimension. Participants appear to move beyond authority-dependent epistemology toward a more evaluative and autonomous orientation. In digital contexts, where information is accessed from multiple platforms and perspectives, this shift is especially significant. It suggests that knowledge construction is increasingly distributed rather than centralized.

Fourth, responses related to perseverance and gradual understanding directly relate to Schommer's dimensions of speed of learning and fixed versus malleable ability. The strong rejection of statements implying that learning should occur quickly or that one should give up when understanding is not immediate indicates a belief that learning is incremental and effort-dependent. Such responses reflect a growth-oriented perspective, suggesting that teaching competence and technological mastery are developed through sustained engagement rather than innate talent. These epistemic dimensions appear closely intertwined with digital engagement. Participants did not merely report using technology; they described adapting digital resources to their own thinking and allowing digital content to reshape their pedagogical perspectives. This suggests that technology functions as a cognitive partner rather than a mechanical tool. In line with Kirschner et al. (2018), meaningful technology integration depends not only on tool availability but also on how teachers conceptualize learning itself.

Although this study was descriptive and did not employ inferential statistical testing, the overall pattern indicates a relationship between epistemic sophistication and reflective digital engagement. Participants who endorsed beliefs about gradual learning and constructed understanding also tended to express stronger appreciation for technology as a medium for exploration and professional growth. Conversely, fixed or authority-dependent beliefs received comparatively low support (Yoon & Song, 2025). These findings reinforce the argument that technological readiness in teacher education cannot be reduced to technical skill acquisition. Instead, it should be understood as embedded within broader epistemological development. When pre-service teachers conceptualize knowledge as evolving, complex, and constructed, they may be better prepared to navigate the ambiguity and multiplicity inherent in digital learning environments.

From a curricular perspective, teacher education programs should therefore integrate structured opportunities for epistemic reflection alongside digital skill development. Encouraging critical inquiry into how knowledge is formed, validated, and revised may deepen the quality of digital pedagogical practices. Digital readiness, in this sense, involves both cognitive flexibility and epistemological maturity, forming a foundation for adaptive and reflective teaching in contemporary educational contexts.

Implications for Teacher Education

The findings of this study suggest that epistemological development should be considered a foundational component of digital competence in teacher education. While many programs emphasize technical proficiency such as operating learning management systems or creating digital instructional materials, this study indicates that the effectiveness of technology

integration is closely linked to how pre-service teachers conceptualize knowledge and learning. Drawing from Schommer's Epistemological Beliefs framework (Schommer et al., 1997), the results demonstrate that beliefs about the certainty, complexity, source, and acquisition of knowledge shape how future teachers engage with digital tools. When knowledge is viewed as evolving and interconnected, technology is more likely to be used as a medium for inquiry, reflection, and conceptual integration (Mason et al., 2010). Conversely, if knowledge is perceived as fixed or authority-bound, digital tools may be reduced to mechanical instruments rather than cognitive resources.

Teacher education curricula should intentionally incorporate opportunities for epistemic reflection. Structured activities such as critical discussions about knowledge construction, analysis of conflicting digital sources, reflective journals on learning processes, and inquiry-based digital projects can foster more sophisticated epistemic orientations (Nayebi Limoodehi & Tahriri, 2014). These practices encourage pre-service teachers to critically evaluate information rather than passively consume it. Digital readiness should be framed as both technical and cognitive preparedness. Beyond mastering applications, pre-service teachers need to develop resilience, patience in learning complex tools, and an understanding that professional growth is incremental. Embedding growth-oriented perspectives into digital pedagogy courses may strengthen long-term adaptability in rapidly changing educational contexts. Preparing future primary mathematics teachers for digital classrooms requires integrating epistemological awareness with technological competence. By cultivating both dimensions simultaneously, teacher education programs can support the development of reflective, adaptive, and intellectually grounded educators capable of navigating the complexities of contemporary learning environments.

Teacher education should not solely focus on technical skills or the ability to operate digital devices. Instead, developing a deep understanding of the nature of knowledge and learning should be part of the core curriculum. For example, by encouraging critical reflection on how prospective elementary mathematics teachers construct their understanding and how they interpret information from various digital sources. Technology-based learning should not only focus on end results (e.g., the ability to create instructional videos or use an LMS), but also on the thinking processes behind the use of technology. By emphasizing pedagogical thinking processes based on a digital cognitive framework, prospective elementary mathematics teachers will learn to view technology as part of a teaching strategy, not simply as a visual aid.

Attitudes toward long-term learning and a willingness to try new things are closely linked to digital engagement, so it is important to develop interventions that foster a growth mindset among prospective teachers. Strategies such as reflective learning, peer coaching, and real-life case studies about the challenges of using technology in the classroom can strengthen their learning resilience. Digital readiness does not simply mean being able to use devices or applications, but also involves a mental readiness to learn continuously and be open to change. Therefore, digital readiness evaluations in teacher education should include both the epistemic dimension and attitudes toward lifelong learning.

The results suggest that participants hold relatively sophisticated epistemic beliefs characterized by flexibility, integration, and developmental awareness. Such orientations are consistent with models of epistemological growth that associate mature beliefs with adaptive learning behaviors (Hofer & Pintrich, 1997). Importantly, participants appear to approach digital technology as part of their cognitive and reflective practice. Rather than perceiving digital tools as external add-ons, they integrate them into their understanding of teaching and learning. This perspective reinforces the notion that digital readiness extends beyond technical proficiency and includes epistemological openness.

Although a minority of responses reflected residual traditional assumptions such as beliefs about innate teaching ability, the overall response pattern indicates a predominant growth-oriented mindset. This is significant, as growth-oriented epistemic beliefs are often associated with greater persistence, adaptability, and willingness to engage with complexity. These findings imply that teacher education programs should not isolate digital skills from epistemological development. Encouraging reflective inquiry into how knowledge is constructed may deepen the quality of digital pedagogical engagement. When pre-service teachers critically examine their own assumptions about knowledge, they are better positioned to integrate technology thoughtfully rather than mechanically.

CONCLUSION

The results of this study indicate that prospective elementary school mathematics teachers generally possess relatively complex and evolving epistemic views. They no longer view knowledge as fixed or simply transferred from lecturer to student, but rather as something that can be actively constructed through reflection and experience. This is reflected in the high level of agreement with statements emphasizing the interconnectedness of subjects and the importance of constructing one's own understanding. The findings of this study also indicate that prospective elementary school mathematics teachers do not simply "use" technology but also interpret it as a space for thinking. They view technology not only as a visual or administrative tool, but also as a medium for constructing understanding, exploring concepts, and developing pedagogical reflection. This is evident in the high scores on statements such as "Digital platforms often update my views on teaching" or "I prefer adapting digital resources to my own thinking."

Some prospective elementary school mathematics teachers still display the influence of fixed views, for example, in the statement "Some people are naturally suited to teaching regardless of effort," the scores on these statements are relatively low. This indicates that the tendency to view teaching ability as innate appears to be increasingly being abandoned. In contrast, the majority of prospective elementary school mathematics teachers believe that pedagogical skills, including those related to the use of technology, can be developed through continuous learning. This finding reinforces the notion that teacher professional development in the 21st century requires not only technological mastery but also a strong and reflective epistemic foundation. The collected data indicates that epistemic beliefs do not stand alone but influence how individuals frame the use of digital tools. For example, those who believe that teaching requires in-depth processing and time (rather than instant results) tend to be more positive about using technology as part of a learning journey, rather than as a quick fix. This demonstrates a reciprocal relationship between how they think about knowledge and the digital pedagogical strategies they choose.

This discussion highlights the importance of viewing technology as an integral part of teachers' professional development, not simply an administrative or curricular requirement. Meaningful use of technology that fosters reflection, creativity, and deep understanding is only possible when prospective teachers possess an open, reflective, and contextualized epistemic framework. In parallel, digital technology is not perceived merely as a functional or administrative instrument. Instead, it is interpreted as a cognitive space, one that supports exploration, reinterpretation, and pedagogical growth. Participants appear to engage with digital tools in ways that extend beyond procedural use, integrating them into their reflective thinking about teaching practice. Although traces of fixed beliefs remain, particularly regarding innate teaching ability such views received comparatively low endorsement. This indicates a broader inclination toward growth-oriented perspectives, where competence is seen as developable through sustained effort and experience. In light of Schommer's multidimensional framework,

these patterns point to advancement across beliefs about the certainty, source, and acquisition of knowledge.

The results underscore that digital readiness in teacher education cannot be reduced to technical skill acquisition. Rather, it is closely intertwined with how future teachers conceptualize knowledge and learning itself. Preparing educators for contemporary classrooms therefore requires attention not only to technological competence, but also to the epistemological foundations that shape how technology is interpreted and enacted in practice. The alignment between sophisticated epistemic beliefs and positive digital engagement underscores the importance of integrating epistemological awareness within teacher education curricula. Preparing digitally competent teachers requires more than technical training; it demands fostering reflective dispositions toward knowledge and learning. Future research may expand this inquiry by employing larger samples and inferential methods to examine the strength of relationships between epistemic dimensions and digital engagement patterns. Such efforts would further clarify how epistemological development contributes to meaningful technology integration.

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REFERENCES

- Ata, R., & Alpaslan, M. M. (2024). The role of digital literacy, epistemological belief and reading motivation and engagement in teaching 21st century skills. *The International Journal of Information and Learning Technology*, 41(3), 304–317. <https://doi.org/10.1108/ijilt-08-2023-0142>
- Blumberga, S., & Vorobjovs, A. (2015). PROBLEMS IN ASSESSING EPISTEMIC AUTHORITY OF UNIVERSITY PROFESSORS. *SOCIETY, INTEGRATION, EDUCATION. Proceedings of the International Scientific Conference*, 1, 56. <https://doi.org/10.17770/sie2014vol1.742>
- Demirbag, M., & Bahcivan, E. (2021a). Comprehensive Exploration of Digital Literacy: Embedded with Self-Regulation and Epistemological Beliefs. *Journal of Science Education and Technology*, 30(3), 448–459. <https://doi.org/10.1007/s10956-020-09887-9>
- Demirbag, M., & Bahcivan, E. (2021b). Comprehensive Exploration of Digital Literacy: Embedded with Self-Regulation and Epistemological Beliefs. *Journal of Science Education and Technology*, 30(3), 448–459. <https://doi.org/10.1007/s10956-020-09887-9>
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed). McGraw-Hill Humanities/Social Sciences/Languages.
- Guo, C., Yan, W., & Guo, Z. (2025). Research on the Implementation Effect of Incentive Policies for Prefabricated Buildings Based on System Dynamics: A Chinese Empirical Study. *Applied Sciences*, 15(10), 5627. <https://doi.org/10.3390/app15105627>

- Hofer, B. K., & Pintrich, P. R. (1997). The Development of Epistemological Theories: Beliefs About Knowledge and Knowing and Their Relation to Learning. *Review of Educational Research*, 67(1), 88–140. <https://doi.org/10.3102/00346543067001088>
- Kirschner, P. A., Sweller, J., Kirschner, F., & Zambrano R., J. (2018). From Cognitive Load Theory to Collaborative Cognitive Load Theory. *International Journal of Computer-Supported Collaborative Learning*, 13(2), 213–233. <https://doi.org/10.1007/s11412-018-9277-y>
- Koçoğlu, Z. (2009). Exploring the technological pedagogical content knowledge of pre-service teachers in language education. *Procedia - Social and Behavioral Sciences*, 1(1), 2734–2737. <https://doi.org/10.1016/j.sbspro.2009.01.485>
- Kong, S.-C., & Lin, T. (2022). High achievers' attitudes, flow experience, programming intentions and perceived teacher support in primary school: A moderated mediation analysis. *Computers & Education*, 190, 104598. <https://doi.org/10.1016/j.compedu.2022.104598>
- Kosse, S., Vogt, O., Wolf, M., König, M., & Gerhard, D. (2022). Digital Twin Framework for Enabling Serial Construction. *Frontiers in Built Environment*, 8, 864722. <https://doi.org/10.3389/fbuil.2022.864722>
- Lee, Y.-H. (2018). Internet-based epistemic beliefs, engagement in online activities, and intention for constructivist ICT integration among pre-service teachers. *Australasian Journal of Educational Technology*, 34(5). <https://doi.org/10.14742/ajet.3747>
- Mason, L., Boldrin, A., & Ariasi, N. (2010). Epistemic metacognition in context: Evaluating and learning online information. *Metacognition and Learning*, 5(1), 67–90. <https://doi.org/10.1007/s11409-009-9048-2>
- Merk, S., Rosman, T., Rueß, J., Syring, M., & Schneider, J. (2017). Pre-service teachers' perceived value of general pedagogical knowledge for practice: Relations with epistemic beliefs and source beliefs. *PLOS ONE*, 12(9), e0184971. <https://doi.org/10.1371/journal.pone.0184971>
- Muis, K. R., Chevrier, M., Denton, C. A., & Losenno, K. M. (2021). Epistemic Emotions and Epistemic Cognition Predict Critical Thinking About Socio-Scientific Issues. *Frontiers in Education*, 6. <https://doi.org/10.3389/feduc.2021.669908>
- Nayebi Limoodehi, R., & Tahriri, A. (2014). A study of epistemological beliefs of EFL learners across gender and educational level. *International Journal of Research Studies in Psychology*, 3(3). <https://doi.org/10.5861/ijrsp.2014.754>
- Nielsen, S. G. (2012). Epistemic beliefs and self-regulated learning in music students. *Psychology of Music*, 40(3), 324–338. <https://doi.org/10.1177/0305735610385509>
- Nyarai Tunjera. (2019). *Teacher Educators' Instructional Strategies in Preparing Pre-Service Teachers to Teach with Digital Technology in the 21st Century*. <https://doi.org/10.13140/RG.2.2.33553.45927>
- Schommer, M., Calvert, C., Gariglietti, G., & Bajaj, A. (1997). The development of epistemological beliefs among secondary students: A longitudinal study. *Journal of Educational Psychology*, 89(1), 37–40. <https://doi.org/10.1037/0022-0663.89.1.37>
- Xiong, X. B., Ching Sing, C., Tsai, C.-C., & Liang, J.-C. (2022). Exploring the relationship between Chinese pre-service teachers' epistemic beliefs and their perceptions of technological pedagogical content knowledge (TPACK). *Educational Studies*, 48(6), 750–771. <https://doi.org/10.1080/03055698.2020.1814698>

Yoon, C., & Song, E. (2025). A Qualitative Study of Pre-Service Teachers' Epistemic Cognition: Implications for Theoretical Model and Measurement. *The Korea Association of Yeolin Education*, 33(4), 267–296. <https://doi.org/10.18230/tjye.2025.33.4.267>