

TECHNOLOGICAL MINDSETS AND TECHNOLOGY INTEGRATION IN ELEMENTARY SCHOOLS: EVIDENCE FROM THE TECHNOLOGY INTEGRATION MATRIX FOR DIGITAL CLASSROOM TRANSFORMATION

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Abstract. The rapid development of digital technologies has increased the need for teachers to integrate technology effectively into classroom learning. However, technology integration depends not only on access to digital tools but also on teachers' technological readiness, beliefs, and pedagogical capacity. This study aimed to examine elementary school teachers' technological mindset, describe classroom technology integration using the Technology Integration Matrix (TIM), and analyze the relationship between technological mindset and technology integration. A quantitative cross-sectional explanatory survey was conducted with 164 elementary school teachers from various provinces in Indonesia. Data were collected using a structured questionnaire that measured technological mindset and five dimensions and five levels of technology integration, based on TIM. Descriptive statistics, Pearson product-moment correlation, and simple linear regression were employed at the 0.05 significance level. The findings showed that teachers had a high level of technological mindset, whereas classroom technology integration was moderate. Among the five TIM dimensions, Active Learning was the strongest, while Goal-Directed Learning was the weakest. The technological mindset was positively and significantly associated with technology integration ($r = .245$, $p = .002$). Regression analysis also showed that technological mindset significantly predicted technology integration ($B = .420$, $p = .002$), although the model explained only 6.0% of the variance. These findings indicate that a technological mindset is an important enabling condition for technology integration, but it is not sufficient to achieve digital classroom transformation. Effective transformation requires the interaction of technological readiness, pedagogical competence, instructional design, professional development, infrastructure, and institutional support.

Keywords: technological mindset, technology integration, elementary school teachers, digital classroom transformation, teacher professional development

INTRODUCTION

Digital transformation has become an important agenda in contemporary education. The rapid development of digital platforms, learning management systems, artificial intelligence, learning analytics, and other educational technologies has expanded opportunities for teaching and learning. However, digital transformation should not be understood merely as the adoption of technological tools. Rather, it requires the effective integration of technology into pedagogical practices to improve the quality, relevance, and meaningfulness of learning (Organization for Economic Co-operation and Development [OECD], 2023; UNESCO, 2023). The OECD (2023) emphasizes that teachers require both general digital skills and teaching-specific digital competences to function effectively in increasingly digital educational environments. UNESCO (2023) similarly emphasizes that technology should serve educational purposes and should not be treated as an end in itself.

Technology integration is a multidimensional process influenced by teachers' knowledge, beliefs, confidence, pedagogical competence, professional development, institutional support, and contextual conditions (Abu Bakar et al., 2018; Consoli et al., 2023; Syahrir et al., 2024; Zeng et al., 2022). The quality of technology integration, therefore, depends on how teachers use technology to support learning rather than simply on whether technology is present in the classroom. A systematic review of technology integration instruments in K-12 education found that the field still lacks a common conceptualization and that assessment should pay greater attention to the pedagogical quality of technology use (Consoli et al., 2023).

Teacher-related factors are particularly important because teachers make the pedagogical decisions that determine how technologies are selected and used. Research on technology-integration self-efficacy demonstrates a positive relationship between teachers' confidence in using technology and their technological pedagogical knowledge (Zeng et al., 2022). Similarly, teacher self-efficacy has been repeatedly identified as an important factor associated with technology integration practices (Abu Bakar et al., 2018). These findings suggest that psychological characteristics and beliefs about technology may influence teachers' willingness and capacity to integrate technology into classroom instruction.

One construct that may help explain these processes is the technological mindset. In this study, technological mindset refers to teachers' beliefs, readiness, attitudes, and adaptive orientation toward educational technology. The construct is conceptually informed by the broader perspective of growth mindset, which emphasizes the possibility of developing abilities through learning, effort, adaptation, and persistence (Dweck, 2006). Applied to educational technology, a positive technological mindset may encourage teachers to view technological challenges as opportunities to learn and improve rather than as barriers to instructional innovation.

Nevertheless, a positive mindset alone may not be sufficient to produce high-quality technology integration. The Technological Pedagogical Content Knowledge (TPACK) framework emphasizes that effective technology integration requires an interaction among technology, pedagogy, content, and context (Mishra & Koehler, 2006). Thus, teachers may have strong technological knowledge or positive attitudes toward technology but still require pedagogical knowledge to translate technology into meaningful instructional practices.

The Technology Integration Matrix (TIM) provides a complementary pedagogical framework for examining the quality of technology integration. TIM consists of five characteristics of meaningful learning environments—Active Learning, Collaborative Learning, Constructive Learning, Authentic Learning, and Goal-Directed Learning—and five levels of technology integration—Entry, Adoption, Adaptation, Infusion, and Transformation (Florida Center for Instructional Technology, 2019). The combination of these dimensions and levels creates a 25-cell matrix that enables the examination of technology integration from both pedagogical and developmental perspectives (Florida Center for Instructional Technology, 2019).

This framework is particularly relevant for elementary education because technology integration at this level should support not only content acquisition but also student engagement, collaboration, knowledge construction, authentic problem solving, and self-regulated learning. Recent research also indicates that technology can support self-regulated learning through goal setting, monitoring, reflection, feedback, and autonomous learning activities (Faza & Lestari, 2025; Prasse et al., 2024).

Despite the growing literature on digital competence, technology acceptance, self-efficacy, and TPACK, empirical research linking teachers' technological mindset with TIM-based technology integration remains limited. This gap is particularly relevant in Indonesia, where digital

transformation in schools is accompanied by differences in teachers' readiness, technological competence, infrastructure, and institutional support.

Therefore, this study investigates elementary school teachers' technological mindset and classroom technology integration using TIM as the analytical framework. Specifically, the study aims to: (1) examine the level of teachers' technological mindset; (2) describe classroom technology integration across the five TIM dimensions and five TIM levels; and (3) analyze the relationship between technological mindset and classroom technology integration.

METHODS

Research Design

This study employed a quantitative cross-sectional survey design to examine the relationship between elementary school teachers' technological mindset and technology integration in classroom learning.

Participants

Participants were elementary school teachers in Indonesia recruited through a national teacher webinar. A voluntary response sampling technique was used. Of the 178 responses received, 14 incomplete or invalid questionnaires were excluded, resulting in a final sample of 164 teachers from various provinces.

Instruments

The questionnaire consisted of two constructs. The technological mindset was measured using 21 items across seven dimensions: technology literacy, technology readiness, attitude toward technology, technology utilization in teaching, innovation and creativity, digital collaboration, and ethics and digital safety. Responses were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Technology integration was measured using 25 items adapted from the Technology Integration Matrix (TIM), representing five meaningful learning characteristics (Active, Collaborative, Constructive, Authentic, and Goal-Directed Learning) across the five TIM integration levels. Responses used a five-point frequency scale (1 = never to 5 = always).

Data Collection

Data were collected online using Google Forms following the webinar. Participants received information about the study, confidentiality, voluntary participation, and provided electronic informed consent before completing the questionnaire. Only valid responses were included in the analysis.

Validity and Reliability

Content validity was established through expert review and pilot testing. Item validity was assessed using the Corrected Item–Total Correlation, with all items meeting the validity criteria ($r > 0.158$, $p < 0.05$). The instrument demonstrated excellent reliability with a Cronbach's Alpha coefficient of 0.965.

Data Analysis

Data were analyzed using IBM SPSS Statistics 27. Descriptive statistics summarized respondents' characteristics and the distributions of variables. Pearson correlation was used to

examine the relationship between technological mindset and technology integration, and simple linear regression was used to assess the predictive effect of technological mindset. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Participation was voluntary, electronic informed consent was obtained from all respondents, and data were collected anonymously. All information was used solely for research purposes and handled confidentially.

RESULTS AND DISCUSSION

A total of 164 elementary school teachers from various provinces in Indonesia participated in this study. Respondents represented diverse employment statuses and levels of teaching experience, providing a broad overview of elementary school teachers in Indonesia. Overall, teachers demonstrated a high technological mindset ($M = 4.30$, $SD = 0.53$).

Table 1. Descriptive Statistics of Technological Mindset

Dimension	Mean	SD	Min	Max
Technology Literacy	4.376	0.586	2.33	5.00
Technology Readiness	4.427	0.606	2.67	5.00
Attitude toward Technology	4.287	0.561	2.67	5.00
Technology Utilization in Teaching	4.226	0.623	2.33	5.00
Innovation and Creativity	4.222	0.615	2.33	5.00
Digital Collaboration	4.348	0.595	2.67	5.00
Ethics and Digital Safety	4.211	0.549	2.67	5.00
Overall Technological Mindset	4.299	0.527	2.95	5.00

As shown in Table 1, Technology Readiness recorded the highest mean ($M = 4.43$), while Ethics and Digital Safety showed the lowest ($M = 4.21$), although both remained in the high category. These findings indicate that teachers are generally well prepared to use educational technology but still require further development in digital ethics and responsible technology use.

Technology Integration

Technology integration measured using the Technology Integration Matrix (TIM) showed an overall moderate level ($M = 3.24$, $SD = 0.90$)

Table 2. Technology Integration Across TIM Dimensions

TIM Dimension	Mean	SD
Active Learning	3.390	0.824
Constructive Learning	3.293	0.974
Authentic Learning	3.205	1.022
Collaborative Learning	3.153	0.978
Goal-Directed Learning	3.137	1.059
Overall TIM	3.236	0.903

Active Learning had the highest mean ($M = 3.39$). In contrast, Goal-Directed Learning had the lowest ($M = 3.14$), suggesting that technology is more frequently used to promote student engagement than to support self-regulated learning.

Across the five TIM implementation levels (Table 3), the Transformation level recorded the highest score ($M = 3.42$). However, differences among the five levels were relatively small, indicating that teachers integrated technology across multiple levels rather than concentrating on a single stage.

Relationship Between Technological Mindset and Technology Integration

Pearson correlation analysis revealed a significant positive relationship between technological mindset and technology integration ($r = .245$, $p = .002$). Although the relationship was relatively weak, teachers with stronger technological mindsets tended to integrate technology more frequently in their teaching.

Simple linear regression further confirmed that technological mindset significantly predicted technology integration ($B = 0.420$, $t = 3.21$, $p = .002$), with the model explaining 6.0% of the variance ($R^2 = .060$). This suggests that other factors, including pedagogical competence, institutional support, infrastructure, and professional development, also influence technology integration.

Table 3. Correlation Between Technological Mindset and Each TIM Dimension

TIM Dimension	r	p
Active Learning	0.301	< .001
Constructive Learning	0.245	.002
Authentic Learning	0.232	.003
Collaborative Learning	0.230	.003
Goal-Directed Learning	0.149	.057

Additional analyses (Table 6) showed that the strongest relationship was found for Active Learning ($r = .301$, $p < .001$), whereas the association with Goal-Directed Learning was not statistically significant ($r = .149$, $p = .057$). These findings indicate that teachers primarily use technology to encourage active participation rather than to support students' self-regulated learning.

Technological Mindset of Elementary School Teachers

The first research question examined teachers' technological mindset. The findings indicate a high technological mindset across all dimensions, including technology literacy, readiness, attitudes, instructional utilization, innovation, collaboration, and digital ethics. This suggests that teachers are generally prepared to adopt educational technology, consistent with previous studies that emphasize digital competence and readiness as prerequisites for technology integration (Abu Bakar et al., 2018; Organization for Economic Co-operation and Development [OECD], 2023; Zeng et al., 2022).

However, a high technological mindset does not necessarily translate into advanced classroom technology integration. While teachers showed strong readiness, technology integration remained moderate, indicating a mindset–practice gap. Consistent with the TPACK framework, effective technology integration requires not only technological readiness but also pedagogical and content knowledge to support meaningful learning (Consoli et al., 2023; Mishra & Koehler, 2006).

Technology Integration Based on the Five TIM Dimensions

The second research question explored technology integration using the Technology Integration Matrix (TIM). Overall, teachers demonstrated moderate technology integration, indicating that technology has been incorporated into teaching but not equally across all dimensions of meaningful learning (Florida Center for Instructional Technology, 2019).

Among the five TIM dimensions, Active Learning achieved the highest score, indicating that teachers frequently use technology to enhance student engagement. However, meaningful learning also requires collaboration, knowledge construction, authenticity, and self-regulation (Florida Center for Instructional Technology, 2019). Constructive Learning ranked second, suggesting that technology supports knowledge construction but has not consistently promoted deeper learning (Consoli et al., 2023). Authentic Learning and Collaborative Learning both showed moderate levels, indicating that technology is used to connect learning with real-world contexts and support interaction, although these practices remain limited and are more likely to emphasize individual engagement than collaborative knowledge construction (Consoli et al., 2023; Florida Center for Instructional Technology, 2019). Goal-Directed Learning recorded the lowest score, indicating limited use of technology to facilitate goal setting, reflection, and self-regulated learning, highlighting the need for greater emphasis on metacognitive learning strategies in teacher professional development (Faza & Lestari, 2025; Prasse et al., 2024).

Technology Integration Across the Five TIM Levels

Across the five TIM levels, Transformation obtained the highest descriptive score, although differences among levels were relatively small. This suggests that teachers integrate technology at different levels depending on instructional goals and classroom contexts rather than consistently operating at the highest level (Florida Center for Instructional Technology, 2019).

Relationship Between Technological Mindset and Technology Integration

The third research question examined the relationship between technological mindset and technology integration. The findings revealed a positive and significant relationship, indicating that teachers with stronger technological mindsets tend to integrate technology more effectively. However, the relatively small correlation suggests that a technological mindset is only one of several factors influencing classroom technology integration (Abu Bakar et al., 2018; Zeng et al., 2022).

Technological Mindset as a Predictor of Technology Integration

Regression analysis confirmed that a technological mindset significantly predicted technology integration, although it explained only 6% of the variance. This indicates that technology integration is also shaped by other factors, including pedagogical competence, TPACK, professional development, school leadership, infrastructure, and institutional support (Consoli et al., 2023; Mishra & Koehler, 2006; Organization for Economic Co-operation and Development [OECD], 2023).

Theoretical Contribution

This study makes three contributions. First, it confirms that a technological mindset is positively associated with the integration of classroom technology. Second, it demonstrates the usefulness of the TIM framework for evaluating the pedagogical quality of technology integration. Third, it identifies a mindset–practice gap, suggesting that a technological mindset is an enabling condition, but not a sufficient condition, for digital classroom transformation.

Implications for Practice

The findings suggest that teacher professional development should move beyond digital literacy toward integrating technology with pedagogy and learning objectives. Greater attention should be given to strengthening Goal-Directed Learning and self-regulated learning through technology. Schools should also provide supportive ecosystems, including infrastructure, continuous professional development, instructional leadership, and collaborative learning communities.

Limitations and Future Research

This study is limited by its cross-sectional design, voluntary sampling, and reliance on self-reported data. Future research should adopt longitudinal or mixed-methods approaches and include additional variables, such as TPACK, digital self-efficacy, school leadership, infrastructure, and professional development, to better explain teachers' technology integration practices.

CONCLUSION

This study found that elementary school teachers demonstrated a high technological mindset but only moderate classroom technology integration. Among the TIM dimensions, Active Learning achieved the highest score. At the same time, Goal-Directed Learning had the lowest, indicating that technology is more frequently used to promote student engagement than to support self-regulated learning. The technological mindset was positively associated with and significantly predicted technology integration. However, its contribution was relatively small, suggesting that other factors, such as pedagogical competence, professional development, infrastructure, and institutional support, also play important roles. Overall, the findings indicate that a technological mindset is an important enabling condition, but not a sufficient condition, for digital classroom transformation. Therefore, teacher development should focus not only on digital skills but also on using technology to create meaningful learning that is active, constructive, collaborative, authentic, and goal-directed.

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