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Main Theme

"Designing the Future: Changing Paradigms and Transhumanism with Artificial Intelligence in Education"

Sub-Themes

- Academic freedom, autonomy, and social responsibility in education
- Artificial intelligence and educational applications
- Augmented reality applications
- Barriers to learning
- Blended learning
- Computer-assisted measurement and evaluation
- Core skill sets for students and teachers
- Design of school buildings in the future
- Designing and delivering a digital strategy
- Digital competence
- Digital parenting
- Distance Education
- Earthquake Education
- Post Earthquake Trauma Training
- Earthquake and Effective Psychosocial Intervention Methods
- Earthquake and Trauma
- The Impact of Earthquakes on School Staff
- Education and society
- Education for healthy living and healthy communities
- Education for a sustainable life
- Education in the digital age: Primary, secondary, high school, higher education, and application examples
- Educational leadership in the digital age
- Effects of regional differences on education
- Equity, Diversity, and Inclusion Related to Marginalized Groups
- Emergency Management at Schools
- Evidence-Based School Counseling Services for Refugees and Marginalized Groups
- Globalisation and Education
- Higher education
- Innovative learning designs for student success
- Instructional technologies in the digital age
- Integration of immigrants into education
- K-12 education (preschool, primary, and secondary education)
- Learning management systems
- Lifelong learning
- Machine learning
- Management information system
- Managing schools
- Measurement and evaluation of students' learning outcomes
- Metaverse
- Migration and education
- Multicultural Classroom Concerns of Educators and Parents
- New educational system after COVID-19
- New skills to live and work in new times
- New technologies in teaching and learning

- New trends in educational research
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- Pedagogy, educational programs, and teaching
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Author Information

This book has been compiled with contributions from 61 authors representing 35 different universities in Turkiye, the United States, and Iran, as well as Turkiye's Ministry of National Education. Among the contributors, there are 51 authors from 31 universities 6 authors from education institutions in Turkey, 3 authors from 2 universities in the United States, and 1 author from a university in Iran.

CONTENTS

Exploring Student Science Teachers' Academic Self-Regulated Learning Strategies in Technology Integration

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Abstract

Teachers' technological experiences are constrained by limitations in reflective decision-making and theoretical frameworks. Challenges with the technological pedagogical content knowledge framework (TPACK) are often associated with deficits in self-regulation. To effectively develop TPACK, it is recommended that educators focus on enhancing self-regulated learning competencies. This study investigates the integration of technology and self-regulated learning (SRL) strategies within the Technological Pedagogical Content Knowledge (TPACK) framework among student teachers. Utilizing a survey methodology with 34 junior student teachers from an elementary science department in Turkey, the research examines their preferences for various technologies and SRL strategies across Technology Enhanced Knowledge of Learner (TEKL), Technology Enhanced Knowledge of Instruction (TEKI), and Technology Enhanced Knowledge of Assessment (TEKA). Findings reveal a preference for multimedia resources and student response systems, highlighting a trend towards interactive and real-time assessment methods. Conversely, digital boards and spreadsheets are less favored due to perceived complexity and insufficient training. The study underscores the importance of goal-setting, planning, and process monitoring as pivotal SRL strategies, aligning with the need for effective technology integration in education. The research further supports the TPACK-SRL approach, emphasizing that self-regulated learning competencies are crucial for the effective development of TPACK. Recommendations include restructuring teacher education programs to offer comprehensive training on diverse digital tools and SRL strategies, aiming to enhance the integration of technology in teaching practices The study contributes to existing literature by linking SRL strategies with technology integration, highlighting their combined impact on enhancing educational outcomes.

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Keywords: Academic self-regulated strategies, TPACK, science teaching, technology integration

Introduction

The Technological Pedagogical Content Knowledge (TPACK) framework is widely acknowledged for its effectiveness in integrating content, pedagogy, and technology in education. The framework was proposed by Mishra and Koehler (2006) and further elaborated by various researchers. However, despite its effectiveness, researchers have identified several challenges, including insufficient technical support, limited time, and inadequate professional development opportunities for teachers to integrate technology into education (Francom, 2019; Guerra et al., 2018). Kramarski and Michalsky (2010) also argue that teachers have limited technological experiences that areguided by reflective decision-making processes and theoretical and conceptual frameworks. Similarly, Pintrich (2000) suggests that teachers face difficulties in TPACK due to deficits in their self-regulation abilities as learners and educators. Hence, there is a recommendation to adopt the TPACK-SRL (Self-Regulated Learning) approach, focusing on teachers' self-regulated learning (Kohen & Kramarski, 2012). This approach emphasizes the importance of all self-regulated learning competencies for teachers to effectively develop TPACK.

The TPACK-SRL approach facilitates the integration of technology, pedagogy, and content, presenting a comprehensive structure of TPACK. According to this approach, all self-regulated learning competencies are crucial for teachers to develop TPACK effectively (Kohen & Kramarski, 2012). In this study, the TPACK framework drawn from Mazlum Güven's research (2022) was utilized. The study employed transformative TPACK, which considers TPACK as a unified and holistic understanding rather than separate components (Schmid et al., 2021). Magnusson et al.'s (1999) Pedagogical Content Knowledge (PCK) framework with Dwyer et al.'s (1991) technology adaptation model were combined to explore participants' enhanced TPACK (E-TPACK). E-TPACK consisted of four dimensions such as Technology Enhanced Knowledge of Learner (TEKL), Technology Enhanced Knowledge of Instruction (TEKI), and Technology Enhanced Knowledge of Assessment (TEKA) (Mazlum-Güven, 2022). For instance, TEKL involves teachers using technology to understand students' learning difficulties and prior knowledge of specific concepts, as well as identifying students with diverse learning styles through technology. This framework stands out for its emphasis on how teachers engage in the instructional process by designing, developing, and integrating technology in the classroom, particularly in relation to students.

Self-regulated learning (SRL) involves actions taken by learners to acquire information or skills, characterized by

agency, purpose, and instrumentality self-perceptions (Zimmerman & Pons, 1986). It is considered as a measurable and powerful agency for better learning by engaging students in analyzing task conditions, forming goals, monitoring and evaluating learning (Mega et al., 2014). Zimmerman and Pons (1986) identified twelve categories of SRL strategies, including self-evaluation, organizing and transforming, goal-setting and planning, seeking information, record-keeping and monitoring, environmental structuring, self-consequences, rehearsing and memorizing, seeking social assistance, reviewing records, and adopting learning behaviors initiated by others.

Self-regulation is crucial for various compelling reasons. For example, Bandura (1982) emphasized the significance of self-regulation for academic success, noting that individuals lacking self-regulation may struggle to maintain focus on tasks, employ effective study methods, and accurately monitor their progress (Azevedo & Feyzi-Behnagh, 2011). SRL also plays a vital role in enhancing the effectiveness of technology integration (Pintrich, 2000) in educational settings by fostering autonomy, persistence, and goal-directed behavior among learners (Broadbent & de Barba, 2023). When combined with digital technologies, SRL empowers teacher candidates to be proactive, self-directed, and self-efficacious, thus supporting a culturally proactive pedagogy in teacher preparation programs (Bembenutty, 2023). Moreover, research on the relationship between self-regulated learning and technology integration in university students demonstrates a positive and statistically significant correlation, emphasizing the importance of instructing students in the planning phase to enhance SRL and technology integration (Chavez et al., 2023). Teachers commonly employ self-regulated learning (SRL) strategies to enhance their Technological Pedagogical Content Knowledge (TPACK) in science education. Research indicates that SRL positively influences TPACK by mediating the relationship between SRL and TPACK, with technological content knowledge (TCK) and technological pedagogical knowledge (TPK) acting as mediatory factors (Sui, Yen & Chang, 2024). However, many studies have reported that teachers often overlook considerations related to SRL when using technology (Kramarski & Michalsky, 2010). Overlooking considerations of self-regulated learning (SRL) in the design of educational technology-based instructional materials can lead to various consequences. Neglecting to address SRL in instructional design can hinder teachers' abilities to effectively integrate technology into their teaching practices and promote students' academic success through efficient learning strategies (Huang & Lajoje, 2021; Lewis & Litchfield, 2011). Despite increasing knowledge of TPACK in various contexts, teachers face challenges in employing SRL strategies for specific components of TPACK (Kohen & Kramarski, 2012). It is crucial to identify which strategies are helpful when integrating technology into teaching. Therefore, this study focused on the strategies adopted for each component of TPACK to address the following research questions:

What specific types of technology did student teachers consider for TEKL, TEKI and TEKA?

Which academic self-regulation strategies did student teachers consider for TEKL, TEKI and TEKA?

What specific types of technology and academic self-regulation strategies did student teachers use in general?

Method

Research Design and Participants

The research employed a survey methodology, encompassing 34 junior student teachers from a state university situated in the Black Sea Region of Turkey. These junior students were enrolled in the elementary science department and had completed fundamental subjects pertinent to science teaching. These subjects included planning and programming, educational technologies, and science teaching courses.

Data Collection Tools and Analysis

The data was collected through a researcher-developed questionnaire, comprising three sections dedicated to TEKL, TEKI, and TEKA. Each section was further divided into two categories. The first category listed various technologies, while the second category included Zimmerman and Pon's (1982) Self-Regulated Learning (SRL) strategies. The strategies were simplified into clear statements and examples to ensure participants could easily grasp them without feeling overwhelmed. After receiving feedback from an expert in science teaching, revisions were made to the draft questionnaire, both in terms of content and format. Following these adjustments, the finalized questionnaire was then administered to the participants for their input. Additionally, participants were verbally briefed about these strategies and examples prior to implementation for a better understanding.

Descriptive analysis was performed by calculating the frequencies of participants' answers for each dimension.

Results

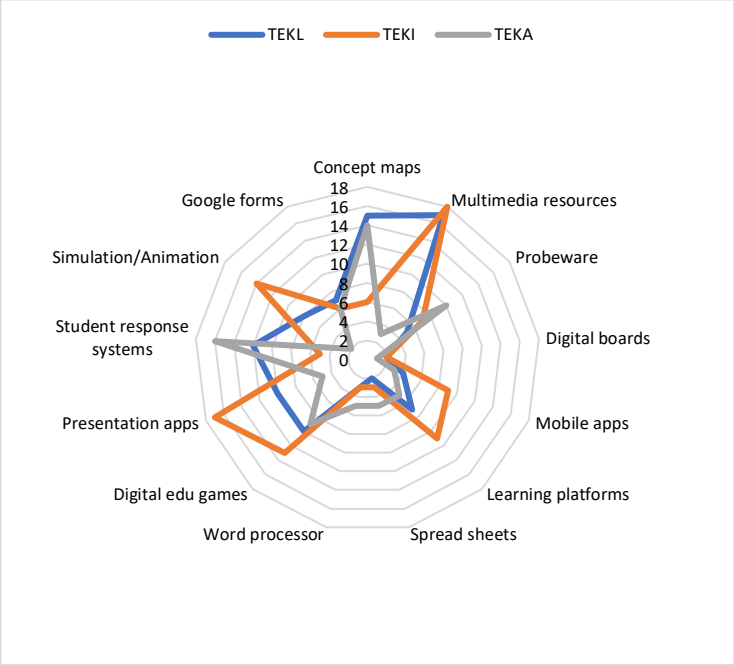
The data derived from the questionnaires indicates that participants employ a variety of technologies in the teaching process (see Figure 1). Among these, multimedia resources, including visuals, voice recordings, and videos, emerge as the most prevalent technologies for both TEKI and TEKL. In contrast, for TEKA, student response systems and concept maps are the predominant choices.

Furthermore, the study reveals that student teachers exhibit a preference for utilizing multimedia resources when assessing learners' knowledge, such as evaluating prior knowledge and identifying misconceptions or learning difficulties. Following multimedia resources, concept maps, and student response systems like Kahoot/Plickers are commonly employed. Conversely, digital boards and spreadsheets emerge as the least favored technologies among student teachers for assessing learner knowledge, as illustrated in Figure 1.

Figure 1 depicts participants predominantly opting for multimedia resources, presentations, and simulations/animations during teaching sessions.

Figure 1

Technologies for TEKL, TEKI and TEKA

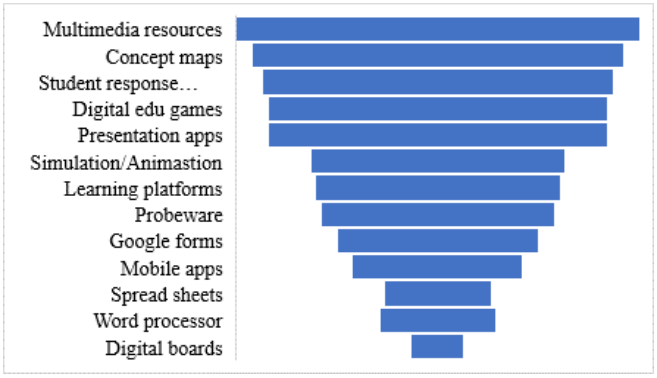


For TEKA, student response systems, concept maps, and scientific equipment such as probeware emerged as the preferred technologies among students. Interestingly, digital boards were consistently less favored across all dimensions.

When examining technologies utilized in general, Figure 2 illustrates that multimedia resources are the most prevalent across all dimensions. Following multimedia resources, concept maps, and student response systems are highly popular among participants. Conversely, digital boards received less attention as one of the least utilized technologies.

Figure 2

Integrated Technologies in General



The analysis of participants' responses concerning academic self-regulated learning strategies culminated in the creation of Figure 3, illustrating the outcomes. As per the depiction in Figure 3, when planning activities to determine students' prior knowledge, misconceptions, or learning challenges, participants predominantly initiate the process with goal establishment and planning. Subsequently, they tend to prioritize record-keeping and process monitoring. Following these stages, reviewing records and engaging in self-evaluation ensue. Notably, self-consequence emerges as the least implemented strategy for TEKL.

Regarding TEKI, the three most common strategies are seeking information, keeping records and monitoring, and reviewing records. Interestingly, self-consequence, which involves students' rewards or punishments in case of success or failure, is the least utilized strategy in this category.

Figure 3

Academic Self-Regulated Learning Strategies for TEKL, TEKI, and TEKA

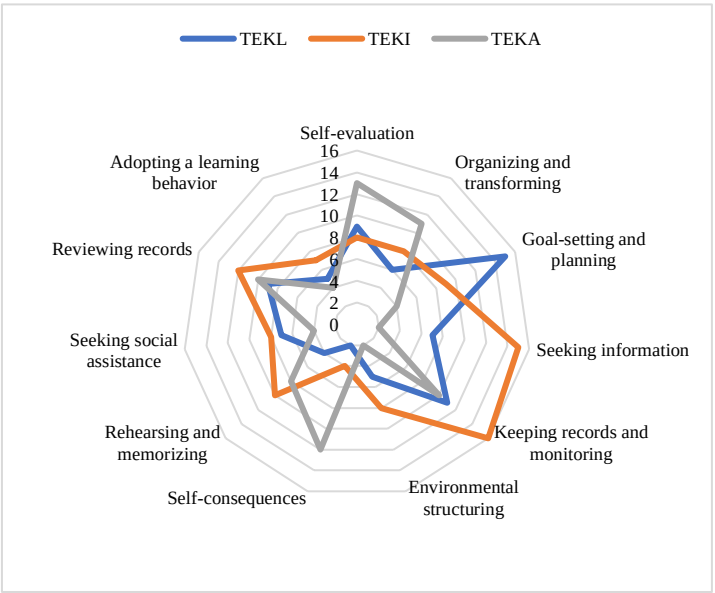
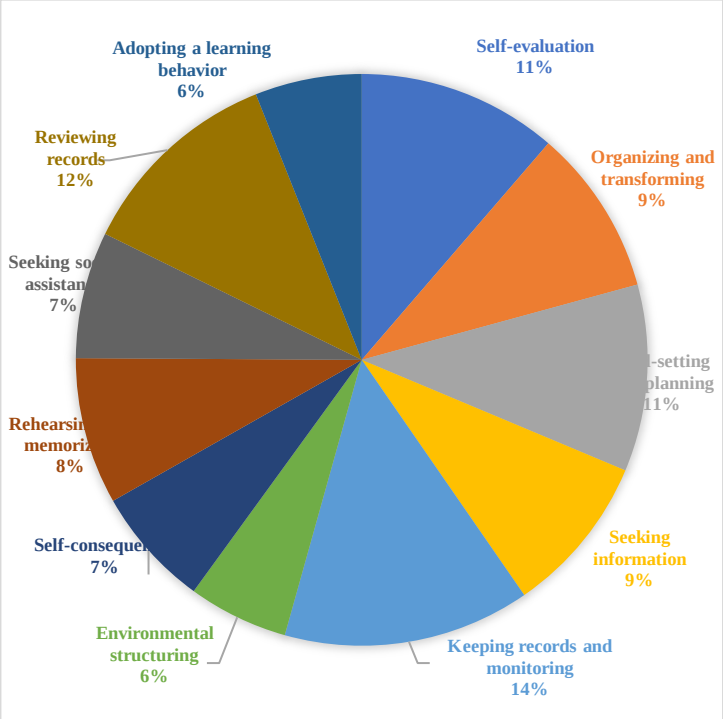


Figure 3 indicates that when planning evaluation and assessment activities, student teachers primarily regulate their process through self-evaluation, self-consequences, and organizing and transforming strategies. Conversely, the least preferred strategies for this dimension are environmental structuring and seeking information.

Upon examining the cumulative results in Figure 4, it becomes apparent that participants predominantly utilize the keeping records and monitoring strategy, while environmental structuring is least utilized across all dimensions.

Figure 4

Academic Self-Regulated Learning Strategies in General



Discussion, Conclusion, and Recommendations

Discussion

The preference for multimedia resources among student teachers in teaching and when determining learners' knowledge indicates a trend towards interactive teaching methods, especially multimedia tools. Multimedia tools, such as videos, provide diverse ways to evaluate students' prior knowledge and address misconceptions. In this study, student response systems, by their very nature, are most likely used primarily for assessment purposes. Student response systems like Kahoot further support active learning, enhance motivation, and assess students' knowledge in real-time (Wang &Tahir, 2020) and are therefore used frequently for assessment. The lower preference for the whole teaching process was digital boards and spreadsheets. Vatanartiran and Karadeniz (2020) propose that the lower preference for these technologies may be attributed to factors such as perceived complexity or inadequate training. Digital boards, while offering interactive visual aids, require specific skills that some student teachers may lack. This indicates a need for enhancing teacher education programs through the restructuring and development of curriculums and lesson designs.

The recent literature reinforces the study's findings regarding the predominant use of goal-setting, planning, and process monitoring in self-regulated learning (SRL). These strategies remain central to SRL and academic achievement (Griffin, Wiley & Salas, 2013; Kizilcec, P'erez-Sanagustín, & Maldonado, 2017). This aligns with the study's results, which show that participants frequently initiate the process of determining students' prior knowledge with goal establishment and planning, followed by record-keeping and monitoring.

Öztürk and Mıhcı Türker have also explored the self-regulated learning (SRL) strategies employed by online learners, identifying that student teachers often engage in preparatory strategies such as organizing their environment and planning before lessons. During lessons, note-taking emerged as the predominant strategy. These findings align with the results of the present study, where participants employed goal-setting and planning strategies to determine learner knowledge (TEKL) prior to instruction. Furthermore, during instruction involving technology, participants utilized strategies such as seeking information and keeping records, consistent with the aforementioned study.

Participants most frequently employed self-evaluation strategies in relation to TEKA. Aras (2023) suggests that virtual methods and tools effectively engage students in reflective practices during distance education, where reflection is facilitated through self-assessment or self-evaluation. Moreover, Ortega-Ruiperez (2022) argues that continuous self-assessment, such as through Moodle surveys, can further enhance self-regulation. The participants' use of self-evaluation in this study aligns closely with findings in educational research, further reinforcing its importance as a critical component of effective self-regulated learning. This alignment suggests that self-evaluation is not only a widely recognized strategy but also an essential practice that facilitates deeper reflection and self-awareness among learners.

Conclusion

The preference for multimedia resources and student response systems among student teachers underscores a growing trend towards interactive teaching and real-time assessment methods, while the lower preference for digital boards and spreadsheets reflects challenges related to complexity and training. To effectively integrate these technologies into teaching practices, it is essential to restructure and enhance teacher education programs to provide comprehensive training on a diverse range of digital tools.

The alignment between this study and existing literature underscores the importance of goal-setting, planning, and process monitoring as essential strategies in self-regulated learning, particularly in the context of effective technology integration within educational settings. Specific self-regulated learning strategies, particularly goal-setting, planning, and process monitoring, are essential during both TEKL and TEKI. These strategies are crucial for effectively integrating technology into teaching practices, as they help educators assess and build upon students' prior knowledge (TEKL) and evaluate learning outcomes (TEKA). The alignment between these strategies and successful technology integration implies that fostering these skills in teacher training programs could enhance the effectiveness of

technology-enhanced education. TPACK-SRL approach (Kohen & Kramarski, 2012) might be integrated with the lessons. This approach ensures that technology enhances both pedagogical strategies and content delivery while promoting students' self-directed learning and reflective practices.

Recommendations

This study examined the types of technologies utilized by teachers when conducting technology-supported instruction and SRL strategies employed within the framework of TPACK. The results obtained from this study are presented above. Based on these findings, several recommendations have been proposed. First, to optimize technology integration in teaching, teacher education programs should focus on providing comprehensive training in a variety of digital tools while emphasizing self-regulated learning strategies like goal-setting, planning, and process monitoring to support effective technology use and enhance educational outcomes. Further, to enhance self-regulated learning, educators should integrate and promote diverse self-regulation strategies and tools within virtual learning environments to support deeper reflection and self-awareness among students.

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