Self Efficacy of Higher Secondary Level Teachers in Techno-Pedagogical Skills: A Review

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Abstract

The incorporation of digital technologies in the education process has completely changed the teaching-learning process, especially following the COVID-19. Self-efficacy is one of the psychological constructs that determine the readiness of teachers to use innovative practices and persevere despite technological problems. This review discusses the self-efficacy of higher secondary teachers in techno-pedagogical skills and analyzes the existing knowledge synthesizing the research to provide understanding of the existing knowledge, gaps, and future directions. Based on TPACK framework and social cognitive approach of Bandura, the results have shown that teacher self-efficacy is a strong predictor of technology integration through professional development, collaborative practice, digital access, and institutional support. The survey reveals that definitions lack consistency and that measurement mechanisms are heterogeneous, which presents the need to have standardized tools. Discussed are implications in teacher education and professional development.

Keywords: Self Efficacy, Techno-Pedagogical Skills, TPACK, Higher Secondary Teachers, Technology Integration

Introduction

Integration of digital technology has highlighted digital competence of teachers in the twenty first century. With institutions utilizing technology in achieving better learning results, the concern is on how well teachers make use of technological tools. This ability, including techno-pedagogical skills and their self-confidence to apply them, has become an important determinant of education quality. Self-efficacy holds an important place among psychological constructs that determine the willingness to implement new practices and the persistence in all cases of facing challenges (Hu et al., 2025).

Self-efficacy which is based on social cognitive theory of Bandura is the belief in an individual ability to perform actions necessitating

the achievement of specified objectives. In the education sector, the teacher self-efficacy is always associated with instructional quality and student engagement, as well as well-being. Self-efficacy has a specific significance when applied to technology integration since the achievement of successful digital tool integration involves confidence to overcome the uncertainties that technology-mediated teaching entails. With high self-efficacy levels, teachers will be able to explore innovative methods and persevere even in challenging times, which will build more meaningful learning contexts (Scherer and Teo, 2019). High technological self-efficacy is associated with the propensity to use emerging technologies, such as AI tools, this connection is mediated by the satisfaction of the basic psychological needs of autonomy and competence (Xia et al., 2025). A properly developed professional learning experience can lead to such efficacy beliefs (Redmond et al., 2025; Paunanthie and Tholappan, 2026).

The higher secondary level is a rather significant environment to consider the techno-pedagogical self-efficacy. Young individuals in the age group of 14-18 years are preparing to join higher education or workforce and thus technology-mediated learning engagement will have a crucial consequence to their future success. The teachers of higher secondary have specific problems involved in balancing the level of discipline and the level of technological innovation, as well as preparing students to take high-stakes exams which might not be fully effective with technology-enhanced practices (Guzmán González and Vesga Bravo, 2024). Professional development has to be situation-dependent and specific to subject backgrounds, and the studies have shown that TPACK self-efficacy varies significantly in diverse disciplinary areas (Hermans et al., 2025). The quick development of generative AI has brought about new aspects of teacher self-efficacy, where one has to be assured knowing how to navigate through AI-generated tools without compromising pedagogical integrity (Cheng et al. 2025). To handle these multifaceted needs, professional development models have to be flexible, which is a feature of the properly developed blended learning models (Paunanthie and Tholappan, 2026).

Theoretical Framework

Bandura's Social Cognitive Theory and Self-Efficacy

In the social cognitive theory, teacher self-efficacy in the integration of technology has its roots. Self-efficacy beliefs are formed in four major sources, including mastery experiences (successful technology integration), vicarious experiences (seeing a colleague successfully use technology), social persuasion (encouragement and feedback), and emotional experiences (affective response to using technology) (Hodges, 2018). These resources are especially applicable in the development of techno-pedagogical skills, as in this case, confidence is formed on the basis of immediate experiences, observation of peers, feedback, and emotional reactions. The deliberate inclusion of such sources in teacher education programs creates long-term efficacy beliefs (Tondeur et al., 2020).

The review showed that literature tends to follow the theory developed by Bandura, but there is a lot of heterogeneity in the definitions and measurement techniques. The modern studies have scaled this framework to analyze self-efficacy as a concept in connection to the new technologies and the results revealed that traditional sources of efficacy are still applicable but need to be applied to the particular area of technology like AI integration (Cheng et al. 2025).

TPACK Framework

The model that is most often used to conceptualize the knowledge needed to implement technologies effectively is Technological Pedagogical Content Knowledge (TPACK) by Mishra and Koehler. Based on the pedagogical content knowledge introduced by Shulman, TPACK describes interaction among technological knowledge, pedagogical knowledge, and content knowledge that describes expert instruction using technology (Joshi, 2023). The relevance of the framework is also

visible in its use to apply to the new areas, including the incorporation of generative AI into the educational process (Zhao et al., 2022).

An efficient integration of technology involves not only the knowledge of how to operate technological devices but also the ways such devices could depict specific content in an accessible manner and how the pedagogical plans could be revised to suit technological possibilities and limitations. Research methods, study samples, domain of subject and methods of evaluation were analyzed using a systematic review of TPACK and self-efficacy of teachers (Joshi, 2023). The review identified that professional development interventions are effective to enhance TPACK self-efficacy, and TPACK-based argumentation practices enhance the overall perceptions regarding technology integration. The framework can be applied at all levels of education, and it is necessary to prepare a modern teacher anywhere in the world (Redmond et al., 2025). More recent research has suggested further developments, including (TPAC)2K frame with the inclusion of computational thinking and digital creation to meet the changing needs of technology-mediated learning (MacCallum 2025).

Integrating Self-Efficacy and TPACK

TPack and self-efficacy have received much attention. Studies indicate that these constructs can be reinforced by each other: educators who have stronger TPACK have higher self-efficacy in technology integration, and educators who are more confident tend to be more willing to experiment and learn to develop TPACK (Hodges, 2018). This mutual relationship carries significant implications on the design of teacher education programs, where a combination of developing knowledge and confidence can be quite effective.

Generative AI usage research indicates that TPACK and self-efficacy have a strong positive predictive value of the intention of teachers to use the tools, and the satisfaction of basic psychological needs (autonomy, competence, relatedness) provides an important mediating value (Xia et al., 2025). Studies show that online teaching self-efficacy and technology attitude partly mediate the relationship between TPACK and behavior intention which shows the relevance of encouraging knowledge and confidence in teacher training (Cheng et al. 2025).

Methodology

Inclusion and Exclusion Criteria

The studies were included in case they: (a) had their research on teacher self-efficacy and technology integration, or techno-pedagogical skills; (b) the research involved secondary or higher secondary teachers; (c) their research had been carried out empirically or as systematical reviews; (d) they were peer-reviewed; and (e), they were in English. The research was filtered away when they were targeted at other levels of education with no second-level participants, or when they did not look at the technology integration but at self-efficacy, or when they were not detailed enough in their methodology. Preference was made to the studies that used validated tools and strong analysis methods (Scherer and Teo, 2019).

Data Extraction and Synthesis

Based on the included studies, data were extracted according to the author(s), year, context of research, theoretical framework, methodology, sample characteristics, key findings regarding to self-efficacy and techno-pedagogical skills, as well as the identified influencing factors. After systematizing it, narrative synthesis was to be performed to arrange the findings in themes (Joshi, 2023). Synthesis was aimed at recognizing patterns through studies but recognizes that there is heterogeneity in definitions and measurement methods (Hu et al., 2025).

Findings

Definitions and Measurement of Techno-Pedagogical Self-Efficacy

The scoping review revealed that there is a large disparity in how self-efficacy and digital competence are defined and measured (Hu et al., 2025). Although the theory of Bandura and EU DigComp is frequently implemented in the studies, self-constructed or modified questionnaires are frequently used by scholars. This heterogeneity of measurement presents difficulty in comparing the results and accumulating knowledge. The review also has observed discrepancies in the TPACK study evaluation methods involving self-perception questionnaires, case studies, classroom observations, and interviews (Joshi, 2023).

The recent widespread international research is based on the validated tools, such as TPACK Core measure, to make the results comparable across settings (Redmond et al., 2025). The specific studies of secondary teachers have already used other instruments, like CT-TPACK survey, modifying TPACK framework to domain-dominated instructional tools, such as computational thinking (Hermans et al., 2025). Development of standardized measurement tools is still a priority.

Relationship Between Self-Efficacy and Technology Integration

The positive relationship that exists between teacher self-efficacy and technology integration has been proved over time. In a research on the factors that affect the intention of K-12 teachers to adopt mobile devices, 132 primary and secondary teachers participated in a partial least squares analysis study, the researchers concluded that attitude, technology beliefs, and self-efficacy on mobile-based teaching significantly and positively affected the intention to adopt mobile devices (Xu and Zhu, 2020). The skills of teachers in using mobile devices and knowledge on pedagogical mobile device were very strong determinants of self-efficacy in mobile based teaching. This connection is also applicable to continuance intention, in which self-efficacy, as well as teaching enthusiasm and resilience, is a significant factor in continuing online teaching practices (Chai et al., 2021). The analysis showed that the impact of subject culture clash on attitudes, technology beliefs, and self-efficacy towards mobile-based teaching was negative and significant (Xu and Zhu, 2020), Studies on AI self-efficacy in K-12 instructors demonstrate that there are substantial differences in perceptions and self-efficacy in terms of previous technology uptake, perceived relevance, and support offered (Bergdahl and Sjöberg 2025)

TPACK Self-Efficacy Among Secondary Teachers

A systematic review of the research on TPACK among in-service secondary teachers that conducted a study to analyze the 2017-2022 research found that papers were grouped into two categories: TPACK perception of teachers (self-perception questionnaires, case studies, relationships with barriers, pedagogical beliefs, online education), and training course development based on TPACK (complemented with questionnaires, observations, interviews) (Guzmán Gonzales and Vesga Bravo, 2024). The results of the first category were not similar as the TPACK levels varied in such variables as gender and teaching experience. Second category found out that professional development is more pro-technological integration. Blended learning models provide flexibility that is required in differentiated, focused, professional growth (Paunanthie and Tholappan, 2026).

Factors Influencing Techno-Pedagogical Self-Efficacy

The scoping review revealed a number of factors that influence digital competence and self-efficacy of teachers: professional development, collaborative practices, access to digital resources, and institutional support (Hu et al., 2025). The professional development turned out to be especially important. The systematic review has identified that professional development interventions are

successful in enhancing TPACK self-efficacy, and TPACK-based argumentation practices enhance the perceptions about technology integration (Joshi, 2023).

A study that investigated the use of ICT professional development with mathematics educators discovered that interventions such as blended learning, training with GeoGebra, and professional communities of practice led to confidence, digital competence, as well as instructional creativity in mathematics (Dahal, 2025). Manageable workload and administrative support are the institutional reasons that are essential to maintain motivation and confidence (especially in online conditions that are demanding).

Barriers and Challenges

Studies have cited a number of barriers to the development of techno-pedagogical self-efficacy. The studies that have explored TPACK perception usually address correlation with barriers such as the access to limited technology, lack of enough technical support, time-related constraints, and unfavorable school culture (Guzmán González and Vesga Bravo, 2024).

A study on AI literacy among physical education teachers indicated that the most common barriers were widespread, with data privacy, training deficiency, and institutional support being rated as strongly agreed obstacles, showing significant negative relationships with Generative AI emergence has created new layers of barriers in that, teachers have to face ethical issues, data privacy, and academic integrity issues in their attempts to utilize AI potential (Bergdahl and Sjöberg 2025).

To overcome barriers, the involvement of multiple strategies, such as the development of professional learning programs that are well-constructed and designed to provide pre-service and in-service teachers with effective learning opportunities and the provision of effective institutional support is required (Tondeur et al., 2020).

Discussion

Synthesis of Key Findings

The review is a synthesis of the research on the techno-pedagogical self-efficacy of higher secondary teachers which shows the important findings. To begin with, teacher self-efficacy is always linked to the topic of technology integration, and research in different contexts proves the existence of this association (Xu and Zhu, 2020; Scherer and Teo, 2019). This association plays a key role in the first adoption and continuation intention, and the mediator of self-efficacy and attitudes were found to mediate between TPACK and behavioral intentions sequentially (Cheng et al. 2025) Second, TPACK framework represents excellent theoretical perspective of the knowledge to be applied in successful technology integration with existing studies showing that professional development interventions mediate TPACK and self-efficacy (Joshi, 2023; Guzmán Gonzalez and Vesga Bravo, 2024; Dahal, 20 The adaptability of frameworks can also be observed in their application to such new areas as computational thinking and generative AI (Hermans et al., 2025; Brennan and Resnick, 2024).

Third, several variables determine the development of techno-pedagogical self-efficacy, such as professional development, collaboration, access to resources, and institutional support (Hu et al., 2025).

Fourth, structured models of professional development have become effective strategies in the development of competencies, but programs should focus on meeting certain teacher needs depending on the stage of their career and the discipline background (Redmond et al., 2025). The blended education model with online and personal learning elements has the potential to provide flexible, accessible, and effective professional development that meets the needs of higher secondary teachers with diversities (Paunanthie and Tholappan, 2026).

Fifth, the AI technologies pose both opportunities and threats to teacher self-efficacy as the research has noted a high level of variation in AI self-efficacy according to past experience, perceived relevance, and support (Bergdahl and Sjöberg 2025).

Implications for Teacher Education and Professional Development

The results are important to teacher education and professional development. Since clear self-efficacy-technology integration relationship is established, teacher preparation must be designed strategically to create experience that develops competence and confidence in techno-pedagogical skills. The perceptions of technology integration can be enhanced by TPACK-based argumentation practices (Joshi, 2023). Professional development is to target technical skills and pedagogical application because pedagogical knowledge has a great impact on self-efficacy (Xu and Zhu, 2020). The effectiveness of the program can be facilitated by a solid theoretical basis, based on the sound pedagogical frameworks, and the authentic experiences between theory and practice (Tondeur et al., 2020).

The context of professional development must be placed in a particular context of discipline taking into consideration that subject culture has a significant influence on attitudes and beliefs (Hermans et al., 2025). The theory developed by Bandura has self-efficacy sources that are used to design professional development to build confidence using mastery experiences, vicarious experiences, social persuasion, and emotional support (Hodges, 2018).

Implications for Educational Policy and Institutional Support

On the institutional and policy levels, this review identifies the need to establish facilitating factors to technology integration. The digital competence and self-efficacy depend on the digital resource access and the support provided by an institution (Hu et al., 2025). Adequate access to technology, sound technical support, and time to go through collaborative planning and professional learning should be provided by the leaders and the policymakers. Technological integration within institutions that place value on it will be able to boost self-efficacy by means of social persuasion and vicarious experiences. The integration of the administrative support should prevent the negative impact of the technostress and directly predict the commitment to online teaching (Cheng et al. 2025) The integration of the structural model of professional development into teacher education and continuous training require support on the policy level. The Blended learning strategies provide scalable cost-effective models of providing professional development in various contexts (Paunanthie & Tholappan, 2026). With the widespread of AI technologies, the policy frameworks should consider the issues of data privacy, ethical standards, and the creation of AI literacy in teachers and students (Bergdahl and Sjöberg 2025).

Limitations and Directions for Future Research

This review has limitations. The teachers of higher levels might not be able to generalize to other levels. The non-English publications could have excluded possible research. The limited scope of meta-analytic synthesis occurs because of heterogeneity in terms of definitions and measurement methods.

The future research must cover a number of directions. To begin with, there should be more standardization in definitions and measurement tools, which allow comparison between studies (Hu et al., 2025). Second, longitudinal studies of the changes in self-efficacy and techno-pedagogical skills over time can help to better understand how intentions convert into sustained practice and how efficacy beliefs change (Cheng et al. 2025) Third, research studies that track changes in self-efficacy and techno-pedagogical skills over time can help to better understand how intentions can be transformed into sustained practice and change in the efficacy beliefs (Tondeur et al., 2020).

Comparison of various models of professional development, such as the blended learning methods, offers significant information (Paunanthie and Tholappan, 2026).

Fourth, the disciplinary context role in the formation of techno-pedagogical self-efficacy still requires research because the subject culture clash implies that subject-specific strategies should be applied (Xu and Zhu, 2020; Hermans et al., 2025). Fifth, with the rise of generative AI, the interplay between self-efficacy and TPACK and willingness to use them should be examined, and professional development should be adjusted to the emerging needs (Xia et al., 2025, Bergdahl and Sjöberg 2025). Lastly, the cross-cultural comparative research on the impact of educational systems, cultural values and the policy environment on the techno-pedagogical self-efficacy is very informative to international teacher education (Redmond et al., 2025).

Conclusion

This review establishes that the self-efficacy of higher secondary teacher in techno-pedagogical skills is a critical determinant of technology integration with certain factors being professional development, collaboration, and resources, and institutional support. The TPACK and self-efficacy that are central to teacher education should be developed by the teacher through mastery experiences, vicarious learning, social persuasion, and emotional support. Professional development must also discuss pedagogical practice in a disciplinary area. With the development of AI, teacher self-efficacy continues to be central to equipping students to survive in a digital future, and evidence-based professional development is one of the major mechanisms to realize these objectives.

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