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Research Article

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An investigation of the relationship between preschool teachers' self-efficacy levels and their technological pedagogical content knowledge (TPACK)

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ABSTRACT

In this study, it was aimed to examine the relationship between preschool teachers' self-efficacy levels and technological pedagogical content knowledge. A total of 384 preschool teachers, working in schools in Tokat province participated in the study. In the data collection process of the study, "Personal Information Form", "Teacher Self-Efficacy Scale" and "Technological Pedagogical Content Knowledge Teacher Observation Form" were used. Pearson Correlation analysis was used in the analysis process of the data obtained within the scope of the study. In the study, it was determined that the self-efficacy levels of teachers and their technological pedagogical knowledge levels were generally at a moderate level. In addition, it was determined that there was a positive and moderately significant relationship between teachers' self-efficacy levels and technological pedagogical content knowledge levels ($p<.05$). These findings highlight the importance of increasing teachers' self-efficacy and technological pedagogical content knowledge.

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Introduction

Preschool education represents a critical stage in children's development, encompassing rapid physical growth alongside psychological, social, and academic progress (Kuzik et al., 2020; Mayra et al., 2022), which has led to an increasing emphasis on preschool education in recent years. Research indicates that significant shifts have occurred in preschool education policies, both in Turkey and in various developed and developing countries (Pianta et al., 2009; Ulus & Çetin, 2022).

Enhancing the professional qualifications of preschool teachers is essential for ensuring that education at this stage effectively fulfills its objectives. Among these qualifications, self-efficacy stands out as a critical competency for preschool teachers. Self-efficacy is fundamentally defined as an individual's belief in their ability to accomplish a task independently (Kurbanoğlu, 2004), and is further elaborated by Çolak et al. (2017) as the confidence in one's capacity to influence others through exhibited behaviors and intended outcomes. According to Arseven (2016), individuals with high self-efficacy recognize the importance of both cognitive and affective processes in achieving success. Furthermore, a strong sense of self-efficacy increases perseverance and determination, ultimately leading to improved performance (Kurt, 2012).

From a professional perspective, a high level of self-efficacy has been shown to positively influence work life, leading to an increased focus on self-efficacy in professional contexts in recent years (Bargsted et al., 2019; Grau et al., 2001). Individuals with strong self-efficacy exhibit higher work motivation and performance, which, in turn, contributes positively to their professional experiences (Canrinus et al., 2012; Çetin & Aşkun, 2017; Dağlar et al., 2018). In this sense, teacher self-efficacy is defined as the belief that teachers can enhance the academic achievement and performance of their students throughout their careers (Kurbanoğlu, 2004). Another definition describes teacher self-efficacy as teachers' judgments

regarding their professional competencies (Ekinci, 2015). Research indicates that teachers with high self-efficacy demonstrate greater commitment to their profession, exhibit positive behaviors, and maintain enthusiasm for teaching (Tschannen-Moran & Hoy, 2001). Given that teacher self-efficacy plays an important role in the effective execution of professional responsibilities, it has increasingly become a focal point of research in recent years (Kırkıç & Çetinkaya, 2020; Guo et al., 2011).

In recent years, particularly with the transition to the digital age, the integration of technology into education has become increasingly widespread. Consequently, adopting a student-centered educational approach rather than a traditional instructional model has emerged as a significant focus. In this context, both teachers' self-efficacy and their technological pedagogical content knowledge (TPACK) are considered critical components of education systems. TPACK influences not only teachers' instructional behaviors but also their attitudes towards integrating technology into the learning process (Arslan & Şendurur, 2017).

TPACK represents the integration of teachers' content knowledge with their technological expertise (Sarı & Bostancıoğlu, 2018). In the context of teachers, TPACK encompasses several competencies, including the ability to solve the problem when faced with a technological problem, adapt to new technologies, follow current technological developments, and effectively utilize necessary technologies. Additionally, it involves the capacity to integrate diverse technological tools into instruction, modify teaching strategies when students struggle with comprehension, manage classrooms effectively, apply previously acquired technological knowledge to teaching practices, and employ technologies that enhance student learning outcomes (Bal & Karademir, 2013). Teachers' levels of TPACK largely determine how effectively they integrate contemporary technologies into their teaching. Studies in the literature indicate that a high level of TPACK positively influences teachers' attitudes and perceptions regarding the use of technology in instructional settings (Albayrak-Sarı et al., 2016; Canbazoğlu-Bilici & Baran, 2015; Tatlı et al., 2016).

Studies show that teacher self-efficacy significantly influences teachers' attitudes towards technological course materials (Atabek, 2020; Dursun, 2019; Kalemoğlu-Varol, 2014). Indeed, research findings suggest that self-efficacy positively impacts attitudes and perceptions regarding technology use in education (Han et al., 2017; Miles, 2013). This relationship implies a potential connection between teachers' self-efficacy and TPACK levels. In the context of preschool education, where teachers are expected to integrate pedagogical, content, and technological knowledge effectively, understanding the factors that influence this integration is of critical significance. Investigating the relationship between teachers' self-efficacy and their TPACK provides valuable insights into their perceptions of professional competence and the extent to which these perceptions are reflected in their instructional practices. However, a review of the literature reveals a limited number of studies supporting this perspective, particularly concerning preschool teachers. Therefore, this study aims to address this gap by examining the relationship between preschool teachers' self-efficacy and TPACK levels, with the expectation that the findings will contribute to enhancing their professional effectiveness.

This study aims to investigate the relationship between preschool teachers' self-efficacy and TPACK levels. For this purpose, the research questions below are addressed.

1. What is the level of preschool teachers' self-efficacy?
2. What is the level of preschool teachers' technological pedagogical content knowledge?
3. Is there a significant relationship between the levels of preschool teachers' self-efficacy and the levels of their technological pedagogical content knowledge?

Method

Research design

In this study, the relational model was employed. This model is fundamentally used to determine relationships between two or more variables (Büyüköztürk et al., 2024). Potential relationships between variables are determined through the relational survey model (Creswell, 2014).

Study group

The population of this study consists of 565 preschool teachers working in preschool education institutions located in the central and district areas of Tokat province. The sample group consists of 384 preschool teachers selected from the population using the convenience sampling method. According to Yazıcıoğlu and Erdoğan (2004), for a population ranging between 500 and 750, a minimum sample size of 226 is required at a 95% confidence interval. With 384 participants, the sample size in this study ensures a balanced representation of the population. The convenience sampling method is defined as a technique in which the

researcher selects the most easily accessible participants from the target population (Patton, 2002). The distribution of the teachers in the sample group according to their demographic characteristics is presented in Table 1.

Table 1. Distribution of demographic characteristics of the participants

Variable	Category	*f*	%
	Female	352	91.7
Gender	Male	32	8.3
	Total	384	100.0
	25-30 years old	87	22.7
	31-35 years old	88	22.9
Age	36-40 years old	71	18.5
	41 years and over	138	35.9
	Total	384	100.0
	1-5 years	90	23.4
	6-10 years	62	16.2
Professional seniority	11-15 years	89	23.2
	16 years and over	143	37.2
	Total	384	100.0
	Undergraduate degree	304	79.2
Educational status	Postgraduate degree	80	20.8
	Total	384	100.0
	Married	279	72.7
Marital status	Single	105	27.3
	Total	384	100.0

As seen in Table 1, among the teachers who participated in the study, 352 (91.7%) were female, while 32 (8.3%) were male. Regarding age distribution, 87 (22.7%) were between 25-30 years old, 88 (22.9%) between 31-35 years old, 71 (18.5%) between 36-40 years old, and 138 (35.9%) were 41 years and over. In terms of professional seniority, 90 (23.4%) had 1-5 years of experience, 62 (16.2%) had 6-10 years, 89 (23.2%) had 11-15 years, and 143 (37.2%) had 16 years and over. Additionally, 304 (79.2%) of the teachers held an undergraduate degree, while 80 (20.8%) had completed postgraduate education. Marital status distribution indicates that 279 (72.7%) were married, whereas 105 (27.3%) were single.

Data collection tools

In this study, data were collected through the Personal Information Form, the Teacher Sense of Efficacy Scale (TSE), and the Technological Pedagogical Content Knowledge Teacher Observation Form (TPCK).

Personal information form

Personal Information Form, consisting of five questions, was used to identify the demographic characteristics of the teachers. This form was developed by the researcher to address the sub-problems of the study. The form aimed to collect data on teachers' gender, marital status, educational background, age, and professional seniority.

Teacher Sense of Efficacy Scale (TSE)

In this study, TSE, developed by Tschannen-Moran and Hoy (2001) and adapted into Turkish with a validity and reliability study conducted by Çapa et al.(2005) was employed. The scale comprises twenty-four items and is structured into three subscales: Student Engagement, including items 1, 2, 4, 6, 9, 12, 14, and 22; Instructional Strategies, including items 7, 10, 11, 17, 18, 20, 23, and 24; and Classroom Management, including items 3, 5, 8, 13, 15, 16, 19, and 21.The scale is structured as a nine-point Likert-type, rated as follows: (1) Inadequate, (3) Somewhat Adequate, (5) Moderately Adequate, (7) Quite Adequate, and (9) Very Adequate. The Cronbach's alpha coefficients for the subscales were calculated as .94 for Student Engagement; .94 for Instructional Strategies, and .95 for Classroom Managament. The total score obtained from the scale represents the general self-efficacy level of teachers. Thus, it can be concluded that the obtained data indicate high reliability (α >.60) (Özdamar, 2013).

Technological Pedagogical Content Knowledge Teacher Observation Form (TPCK)

In this study, TPCK, developed by Dal (2015), was used to assess teachers' technological pedagogical content knowledge. It consists of seven subscales with a total of 49 items. The subscales are as follows: Technological Knowledge (7 items), Content Knowledge (7 items), Pedagogical Knowledge (7 items), Pedagogical Content Knowledge (8 items), Technological Content Knowledge (7 items), Technological Pedagogical Knowledge (7 items), and Technological and Pedagogical Content Knowledge (6 items). TPCK is structured as a five-point Likert type, rated as follows: (1) Completely Insufficient, (2) Insufficient, (3) Average, (4) Sufficient, to (5) Completely Sufficient. A higher total score from the form indicates a higher

level of technological pedagogical content knowledge. The Cronbach's alpha coefficients calculated for the subscales were calculated as .95 for the Technological Knowledge, .95 for the Content Knowledge, .95 for the Pedagogical Knowledge, .96 for the Pedagogical Content Knowledge, .96 for the Technological Content Knowledge, .97 for the Technological Pedagogical Knowledge, and .96 for the Technological Pedagogical Content Knowledge. Therefore, it can be concluded that the obtained data indicate high reliability (α >.60) (Özdamar, 2013).

Data collection

The data of the study were collected in the spring term of the 2023-2024 academic year. The data were collected online on a voluntary basis through Google Forms, which included instructions explaining the content and purpose of the study.

Data analysis

The collected data within the scope of the study were analyzed using SPSS 25.0. First, Cronbach's alpha coefficients for the subscales and stratified alpha coefficients for the overall scales were calculated to assess the reliability of the data. Additionally, skewness and kurtosis coefficients were examined to evaluate the normality of the data distribution. The calculated skewness and kurtosis coefficients are presented in Table 2.

Table 2. Skewness and kurtosis values of scale scores

Subscales	Skewness	Kurtosis
Student Engagement	-.45	-.16
Instructional Strategies	-.38	-.14
Classroom Management	-.39	-.16
Total of TSE	-.44	-.06
Technological Knowledge	-.45	-.06
Content knowledge	-.72	.33
Pedagogical knowledge	-.67	-.07
Pedagogical content knowledge	-.77	.63
Technological content knowledge	-.74	.55
Technological pedagogical knowledge	-.59	.12
Technological pedagogical content knowledge	-.50	-.16
Total of TPCK	-.62	.32

When Table 2 is examined, it is seen that the skewness and kurtosis values are between -2 and +2, which is suitable for normal distribution (George & Mallery, 2019). Accordingly, it can be inferred that the obtained data from both the subscales and the overall scales indicate normal distribution characteristics.

Findings

In this section, the findings related to the sub-problems of the study are presented.

Findings related to the first sub-problem

The descriptive statistics related to the first sub-problem of the study, 'What is the level of preschool teachers' self-efficacy?' are presented in Table 3.

Table 3. Descriptive statistics related to TSE scores

Subscales	n	$\bar{X}$	sd
Student Engagement	384	29.80	5.59
Instructional Strategies	384	29.85	5.97
Classroom Managament	384	29.82	5.92
Total of TSE	384	89.37	16.95

When Table 3 is analyzed, it is seen that the mean scores for the 384 teachers participating in the study are ($\bar{x}$=29.80; sd=5.59) in the Student Engagement subscale, ($\bar{x}$=29.85; sd=5.97) in the Instructional Strategies subscale, ($\bar{x}$=29.82; sd=5.92) in the Classroom Managament subscale, and ($\bar{x}$=89.37; sd=16.95) for the total score of the scale. Considering the mean scores of both the subscales and the total score of the scale, it can be concluded that teachers' self-efficacy levels are at a moderate level.

Findings related to the second sub-problem

The descriptive statistics related to the second sub-problem of the study, 'What is the level of preschool teachers' technological pedagogical content knowledge?' are presented in Table 4.

Table 4. Descriptive statistics related to TPCK scores

Subscales	n	$\bar{X}$	sd

Technological knowledge	384	27.99	4.73
Content knowledge	384	29.32	4.48
Pedagogical knowledge	384	29.79	4.44
Pedagogical content knowledge	384	33.47	5.16
Technological content knowledge	384	29.26	4.79
Technological pedagogical knowledge	384	28.53	5.04
Technological pedagogical content knowledge	384	24.61	4.23
Total of TPCK	384	202.97	29.99

When Table 4 is analyzed, it is seen that the mean scores for the 384 teachers participating in the study are ($\bar{x}$=27.99; sd=4.73) in the technological knowledge subscale, ($\bar{x}$=29.32; sd=4.48) in the content knowledge subscale, ($\bar{x}$=29.79; sd=4.44) in the pedagogical knowledge subscale, ($\bar{x}$=33.47; sd=5.16) in the pedagogical content knowledge subscale, ($\bar{x}$=29.26; sd=4.79) in the technological content knowledge subscale, ($\bar{x}$=28.53; sd=5.04) in the technological pedagogical knowledge subscale, ($\bar{x}$=24.61; sd=4.23) in the technological pedagogical content knowledge subscale, and ($\bar{x}$=202.97; sd=29.99) for the total score. Considering the mean scores of both the subscales and the total score, it can be concluded that teachers' technological pedagogical content knowledge levels are generally at a moderate level, except for the pedagogical knowledge subscale, where they are at a high level.

Findings related to the third sub-problem

Within the third sub-problem of the study, Pearson correlation analysis was conducted to examine the relationship between teachers' self-efficacy and technological pedagogical content knowledge. The correlation coefficients are presented in Table 5.

Table 5. Results of the pearson correlation analysis

Subscales	Student engagement	Instructional Strategies	Classroom Management	Total of TSE
Technological knowledge	.461*	.511*	.432*	.483*
Content knowledge	.548*	.577*	.502*	.559*
Pedagogical knowledge	.525*	.544*	.502*	.540*
Pedagogical content knowledge	.505*	.513*	.465*	.510*
Technological content knowledge	.453*	.481*	.411*	.462*
Technological pedagogical knowledge	.450*	.489*	.413*	.465*
Technological pedagogical content knowledge	.454*	.486*	.397*	.460*
Total of TPCK	.531*	.563*	.489*	.544*

*p<.05

When Table 5 is examined, it is seen that there is a positive and moderately significant relationship (r>.40; p<.05) between all subscales related to teacher self-efficacy levels and total score, and all subscales related to technological pedagogical content knowledge and total score. In other words, as teachers' technological pedagogical content knowledge increases, their self-efficacy also increases and these two variables affect each other positively.

Discussion, conclusion and recommendations

Based on the obtained findings of the current study, it was concluded that teachers' self-efficacy levels were at a moderate level. Similarly, the mean scores for the subscales of student engagement, instructional strategies, and classroom management were also found to be at a moderate level. Contrary to these findings, previous research on teacher self-efficacy in Turkey generally indicates that teachers exhibit high self-efficacy levels (Dolapcı & Kavgacı, 2020). For instance, a study conducted by Aslan and Kalkan (2018) with secondary and high school teachers revealed that teachers demonstrated high self-efficacy levels across the subscales of student engagement, classroom management, and instructional strategies. Moreover, the same study reported that teachers possessed a high level of overall self-efficacy belief. A study conducted by Buluç and Demir (2015) with primary and secondary school teachers found that teachers' self-efficacy levels were above the moderate level. Similarly, Coşkun (2019), in a study involving secondary school teachers, determined that their self-efficacy levels were above the moderate level. Likewise, Çam (2017) concluded that primary school teachers exhibited high levels of general self-efficacy. The same study also revealed that teachers' self-efficacy levels in the subscales of instructional strategies, classroom management, and student engagement were similarly high. Furthermore, it has been suggested that teachers' high self-efficacy levels contribute to the establishment of a constructivist learning environment (Koç, 2013).

Variations in research findings regarding teachers' self-efficacy levels may be attributed to factors such as school climate, organizational culture, and administrator behaviors. Supporting this perspective, several studies have emphasized that factors related to school and administration significantly influence self-

efficacy levels (Aldridge & Fraser, 2016; Arslan, 2019; Dahlkamp et al., 2017; Hosford & O'Sullivan, 2016; İpek et al., 2018). Additionally, research findings indicate significant relationships between self-efficacy, motivation, and performance (Cherian & Jacob, 2013; Vancouver & Kendall, 2006). Studies further suggest that as teachers' self-efficacy levels increase, their motivation to work also improves (Recepoğlu, 2018). In line with this, Abuswireh (2020) found a significant positive relationship between teachers' self-efficacy perceptions and their work motivation. Moreover, higher self-efficacy levels in teachers are associated with increased psychological well-being, which, in turn, positively influences their professional lives and commitment to their schools (Ağaçbacak, 2019). In the current study, the finding of a moderate level of self-efficacy among preschool teachers may reflect a relatively narrow perceived competence in the management of instructional processes, the facilitation of student engagement, and the application of effective teaching strategies. The finding may also be attributed to the multidimensional nature of preschool education, where instructional responsibilities are closely linked to developmental, emotional, and contextual dynamics unique to this stage of education.

Based on the results related to teachers' TPACK levels, it was revealed that their levels of technological knowledge, content knowledge, pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge, technological pedagogical content knowledge, and overall TPACK were generally at a moderate level. Studies in the literature suggest that teachers' TPACK levels generally range from above moderate to high (Deniz & Avcı, 2023; Gülşen, 2023). Similarly, in a study conducted by Coşkun (2019) with secondary school teachers, it was found that teachers had scores close to high in the dimensions of technological knowledge, pedagogical knowledge, technological content knowledge, and technological pedagogical content knowledge, while their scores in content knowledge and pedagogical content knowledge were at a high level. However, a study by Akyar (2019) examining secondary school teachers' technological pedagogical knowledge levels found that their technological knowledge was relatively low, with the highest scores in content knowledge.

An analysis of the relationships between the dependent variables in this study revealed that there were positive and moderately significant relationships between teachers' self-efficacy levels and TPACK levels. Similarly, significant positive relationships were identified among the subscales. Notably, similar findings have been reported in previous studies conducted with teachers from various disciplines. For instance, Bal (2017) found a significant and positive relationship between science teachers' personal self-efficacy levels and their technological pedagogical knowledge levels. Likewise, in a study by Çam (2017) involving primary school teachers, a significant positive correlation was observed between teachers' general self-efficacy levels and their technological pedagogical knowledge levels. Moreover, the same study indicated that teachers' self-efficacy levels positively influenced their attitudes toward technology. In a study conducted by Coşkun (2019) with secondary school teachers, it was concluded that teachers' self-efficacy levels had a positive impact on their technological pedagogical knowledge levels. Similarly, Demirci (2021), in a study involving both in-service and pre-service teachers, found that participants' self-efficacy levels positively influenced their TPACK levels. Furthermore, in the study of Kaşcı (2021), it was determined that the relationship between classroom teachers' technological pedagogical knowledge levels and their self-efficacy beliefs was significant and positive. In this context, the findings indicate that as classroom teachers' technological pedagogical knowledge levels increase, their self-efficacy beliefs also increase. In a study conducted by Gözel (2022) with classroom teachers, a significant and positive relationship was identified between teachers' self-efficacy levels for technology use and their technological pedagogical knowledge levels. Similarly, Çetin (2024) found that as teachers' technological pedagogical knowledge levels increased, their self-efficacy levels regarding online teaching also improved. Overall, the literature suggests that teachers' ability to integrate contemporary and diverse teaching methods alongside traditional approaches is closely linked to their self-efficacy levels (Doğan, 2024).

Future research may consider the following directions:

1. Future studies may examine the relationship between teachers' self-efficacy levels and their TPACK in relation to various demographic variables, such as school type, in-service training status, department of graduation, and years of experience within the same institution.
2. Researchers may compare self-efficacy and TPACK levels among teachers from different branches to identify potential disciplinary differences.
3. Qualitative and mixed-method studies may be conducted to provide deeper insights into the relationship between self-efficacy and TPACK.
4. Applied technology training programs may be developed to support preschool teachers in enhancing their technological knowledge and skills.
5. Professional development programs focusing on the effective use of Web 2.0 tools may be implemented to encourage teachers to design and utilize their own digital instructional materials.

6. Training programs may be organized in small groups, considering the teachers' current levels of technological competence, in order to maximize their effectiveness.
7. Future research may investigate how teachers' levels of self-efficacy and TPACK influence their attitudes toward technology integration in teaching.

Lastly, the study employed a convenience sampling method and was limited to preschool teachers from a single province, which may constrain the generalizability of the findings to broader populations. In addition, the exclusive use of quantitative methods may have limited a more comprehensive understanding of teachers' experiences and the contextual factors influencing their professional practices.

Declarations

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Competing interests

No potential conflict of interest was reported by the authors.

Ethics statements

The study, a part of master thesis, was conducted according to ethical considerations.

Informed consent

Written consent was obtained from all participants.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Authors' contributions

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Artificial intelligence

Artificial intelligence was not used in the preparation of this article.

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