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Unveiling Pre-Service Teachers' Self-Efficacy: A Comprehensive Analysis of Teaching Materials Utilization

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ABSTRACT

This study investigated pre-service teachers' self-efficacy in teaching materials utilization (TMU) focusing on the aspects of message design, usage, and visual design, and how demographic factors such as gender, age, university type, year of study, and teaching branch affect their self-efficacy in TMU. A group of 347 pre-service teachers studying at the faculty of education in different universities across Turkey were measured for their self-efficacy in the aspects of message design, usage, and visual design in teaching materials. The study quantitatively revealed that pre-service teachers demonstrated high levels of self-efficacy in all three domains. Notably, pre-service teachers' self-efficacy varied significantly across demographic variables. Female pre-service teachers generally exhibited higher self-efficacy across all the subscales compared to their male counterparts. Age was also found to influence their self-efficacy in that older participants displayed greater competence. The pre-service teachers from foundation universities showed higher self-efficacy than those from state universities. However, the year of study did not significantly affect self-efficacy levels. Furthermore, significant differences in self-efficacy were also observed across different teaching branches, particularly in message design and usage, but not in visual design. This study contributes valuable insights for teacher education programs by emphasizing the importance of demographic considerations in developing teaching materials competencies among pre-service teachers.

1. Introduction

In the realm of education, the effectiveness and success of teachers depend on their self-efficacy, which is the confidence in their ability to address teaching responsibilities and educational challenges such as incorporating instructional resources, tools, and materials into the learning environment (Akhter et al., 2022). According to Bandura (1997), self-efficacy refers to an individual's belief in their capacity to organize and carry out actions towards specific goals or outcomes. Teachers' self-efficacy regarding teaching materials utilization (TMU) encompasses their beliefs about implementing strategies or actions that are crucial for integrating instructional materials effectively within their teaching practices.

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Teacher self-efficacy is significant for the successful implementation of effective teaching practices (Johnson, 2023). The higher the level of self-efficacy, the more confident and capable teachers are in choosing, designing, and using teaching materials in their instruction, and this belief influences how deeply they are involved in using various instructional resources (Akhter et al., 2022; Hoy, 2022). In addition to promoting learners' motivation towards achievement, such confidence also tends to prompt them to continue performing tasks or even keep trying new alternatives and strategies (Barni et al., 2019; Shukri & Matore, 2023). Creating self-efficacy among teachers can positively influence student success (Manasia et al., 2020); therefore, it is a subject of focus for educational leaders and professional development efforts.

Pedagogical resources act as a repository of information and a tool for the learning process, without which learners will fail to enhance their learning efficacy and meet their objectives in time (Susilaningsih et al., 2022). Teachers need to have a high level of self-efficacy to use these materials effectively. The self-efficacy related to the teachers' materials utilization concerns the belief in their ability to organize, integrate, and apply different teaching materials in the process of instruction (Barni et al., 2019). Acknowledging and fostering teacher self-efficacy in utilizing teaching materials not only strengthens educators' professional skills but also plays a direct role in achieving enhanced and efficient student learning outcomes. Essentially, the interdependence between teacher self-efficacy and the successful application of teaching materials is crucial for shaping a resilient educational environment.

In this respect, understanding and assessing pre-service teachers' self-efficacy in TMU directly influences teacher education programs and professional development initiatives. Higher self-efficacy for using instructional materials is generally associated with more effective teaching practices, higher motivation, and better student outcomes. Pre-service teachers with a high level of self-efficacy in TMU can effectively develop more innovative instructional strategies and proficiently employ different kinds of teaching materials to meet the diverse needs of their students. Therefore, this study sought to identify the level of pre-service teachers' self-efficacy in TMU including the factors of message design, usage, and visual design with the exploration of the relationship between the demographic variables and their self-efficacy in TMU. The results contribute to practical implications for improving instructional practices in teacher education programs. Insights into the specific constructs of self-efficacy related to TMU can inform educators about areas where pre-service teachers may need additional support or training.

2. Theoretical Background

2.1. Self-Efficacy in TMU

Teacher self-efficacy is a critical factor in the effective utilization of teaching materials because of its impact on teachers' confidence and ability to adapt and implement resources in diverse educational contexts. Self-efficacy is associated with teachers' instructional practices (Li & Xu, 2021; Yoon & Goddard, 2023), their engagement with professional development (Gerber et al., 2024; Lemon & Garvis, 2015), and their ability to foster student learning outcomes (Salles et al., 2020; Hartell, 2017). As Yoon and Goddard (2023) proved, teacher self-efficacy significantly mediates the relationship between professional development quality and instructional effectiveness due to its influence on clarity of instruction, cognitive activation, and classroom management. Similarly, Li and Xu (2021) indicated that teachers with high self-efficacy are more likely to engage in innovative teaching practices and adapt materials effectively to meet students' needs. This tendency to innovate can lead to more dynamic and effective teaching practices (Hahn et al., 2022). Moreover, higher levels of self-efficacy in

teachers are linked to better student engagement and achievement. Teachers who believe in their abilities are more likely to create engaging and effective learning environments, which can lead to improved student performance (Hartell, 2017).

Korkmaz (2011) investigated self-efficacy in TMU in three constructs: message design, usage, and visual design. Message design refers to the thoughtful and intentional crafting of content within instructional materials to effectively communicate educational concepts. As a fundamental fragmented structural component of instructional strategy, the message construct serves as a link between low-level conversational components and high-level strategic aims (Gibbons & Boling, 2021). Instructional message design utilizes learning theories and various technologies like typography, color, multimedia, and visual communication tools to effectively communicate information to learners (Ramlatchan, 2019). Alyahya and Nasser (2019) proved a strong correlation between students' memory ability and the use of color in instructional infographic designs. By incorporating these elements, message design ensures the intentional crafting of content within instructional materials to facilitate effective communication of educational concepts.

Usage, in the context of TMU, pertains to how instructional materials are applied, integrated, and implemented in the teaching and learning process (Korkmaz, 2011). Effective usage of instructional materials in teaching is essential for expected learning outcomes (Guerrettaz et al., 2022; Harwood, 2021; Krajcik & Delen, 2017). Choppin et al. (2022) found that instructional materials play a significant role in mediating the relationship between the official curriculum and classroom instruction. Therefore, the efficient use of instructional materials is fundamental for students to successfully interact with the subject, and for teachers to create a conducive learning environment and achieve successful educational outcomes.

Visual design refers to the aesthetic and functional aspects of the visual elements within instructional materials including layout, graphics, and formatting (Korkmaz, 2011). A well-designed layout can enhance readability and organization by directing learners' attention to key details along with improving overall comprehension (Bhat & Alyahya, 2024; Ghai & Tandon, 2022). Teachers can optimize the overall learning experience for students and create a more favorable learning setting by including visually appealing and practical aspects in their teaching materials.

Consequently, message design, usage, and visual design are interrelated aspects of TMU, and effective TMU involves creating clear and well-structured messages, strategically using materials in the teaching process, and paying attention to the visual presentation to enhance learning experiences for students. Through the compatible integration of these elements, teachers may maximize the use of teaching materials to design compelling and productive learning experiences that foster a deeper comprehension of concepts and enable significant learning outcomes. When instructional materials are well designed, strategically implemented, and visually stimulating, students are more likely to stay engaged, understand complex concepts more easily, and retain information longer.

2.2. Study Context

In educational settings, teacher self-efficacy is required for effective teaching practices, particularly in the integration of instructional resources within the classroom. Therefore, self-efficacy in TMU should be developed at the initial training stage of pre-service teachers. Teacher education cannot only depend on equipping future educators with content knowledge but their belief in their capacity should also be fostered to effectively implement instructional practices and resources in the classroom. Serving as a crucial foundation where future educators can develop their self-efficacy, teacher education programs can support pre-service

teachers in fostering their self-efficacy in TMU as a core component of instructional success (Akhter et al., 2022). The confidence provided during this formative training period allows pre-service teachers to transition more smoothly into professional roles, where they must frequently adapt to new materials, technologies, and teaching strategies to meet diverse student needs (Barni et al., 2019; Hoy, 2022).

In this context, self-efficacy related to TMU becomes critical in pre-service teacher training. Programs that emphasize the three key components; namely, message design, usage, and visual design, help future teachers develop both the practical skills and the confidence they need to integrate materials into their lessons effectively. When pre-service teachers engage in training that focuses on these aspects of instructional design (Korkmaz, 2011), they can craft content that aligns with pedagogical goals, use resources effectively during instruction, and apply visually engaging materials that enhance student comprehension. Therefore, training programs should provide various opportunities for pre-service teachers to practice and receive feedback on their materials design and usage by building their belief in their capacity to innovate and manage diverse classroom settings. This approach contributes to creating a resilient, adaptable teaching workforce capable of continuously improving student learning outcomes throughout their careers (Manasia et al., 2020).

3. Methodology

3.1. Research Design

This study quantitatively identified the level of pre-service teachers' self-efficacy in TMU including the factors of message design, usage, and visual design with the exploration of the relationship between the demographic variables and their self-efficacy in TMU. Accordingly, the following research questions (RQs) were investigated:

RQ1. What is the level of pre-service teachers' self-efficacy in TMU?

- RQ1.1. What is the level of pre-service teachers' self-efficacy in the message design of instructional materials?
- RQ1.2. What is the level of pre-service teachers' self-efficacy in the usage of instructional materials?
- RQ1.3. What is the level of pre-service teachers' self-efficacy in the visual design of instructional materials?

RQ2: Do pre-service teachers' self-efficacy in TMU vary by demographic variables?

- RQ2.1. Do pre-service teachers' self-efficacy in TMU vary by gender?
- RQ2.2. Do pre-service teachers' self-efficacy in TMU vary by age?
- RQ2.3. Do pre-service teachers' self-efficacy in TMU vary by university type?
- RQ2.4. Do pre-service teachers' self-efficacy in TMU vary by year of study?
- RQ2.5. Do pre-service teachers' self-efficacy in TMU vary by teaching branch?

RQ1 was designed to determine the overall confidence and belief in their ability among pre-service teachers to effectively utilize teaching materials in their instructional practices in addition to their self-efficacy in the constructs of message design, usage, and visual design. RQ2 sought to explore whether demographic factors such as gender, age, university type, year of study, and teaching branch have an impact on pre-service teachers' self-efficacy in TMU.

3.2. Participants

In this study, convenience sampling was selected as a non-probability sampling technique, which is described as the sample readily available, accessible, and applicable to almost any research (Golzar et al., 2022). Accordingly, the sample of this research consisted of 347 pre-service teachers studying at the faculty of education in different universities across Turkey. The characteristics of the participants are presented in Table 1 along with the descriptive analysis of the demographic variables.

Table 1.
Sample Characteristics

Gender	**n**	**%**	**Teaching Branch**	**n**	**%**
Male	77	22	Turkish Language Teaching	46	13.26
Female	270	78	Mathematics Teaching	43	12.39
Age			Primary School Teaching	39	11.24
$\bar{X}$±SD	22.20±3.641		Pre-school Teaching	34	9.80
University Type	**n**	**%**	Science Teaching	31	8.93
State	336	97	Social Studies Teaching	31	8.93
Foundation	11	3	English Language Teaching	28	8.07
Year of Study	**n**	**%**	Psychological Guidance and Counseling	28	8.07
1st year	98	28	Religious Education Teaching	22	6.34
2nd year	76	22	Art Teaching	11	3.17
3rd year	59	17	Special Education Teaching	11	3.17
4th year	91	26	Physical Education Teaching	8	2.31
5th year or more	23	7	Information Technologies Teaching	5	1.44
Faculty of …	**n**	**%**	German Language Teaching	4	1.15
			Music Teaching	4	1.15
Education	347	100	French Language Teaching	1	0.29
			Spanish Language Teaching	1	0.29
Total				**347**	**100.00**

As listed, of 347 respondents, male pre-service teachers comprised 22% (n=77) while females represented a larger proportion at 78% (n=270). The average age of participants was 22.20 years with a standard deviation (SD) of 3.641. Regarding university type, a significant majority, 97% (n=336), was attending state universities, whereas a smaller fraction, 3% (n=11), was enrolled in foundation universities. When examining the distribution by year of study, first-year students formed the largest group at 28% (n=98), followed by second-year students at 22% (n=76), third-year students at 17% (n=59), fourth-year students at 26% (n=91), and those in their fifth year or beyond at 7% (n=23). All the participants were studying at the faculty of education in different Turkish universities across the country totaling 100% (n=347). The teaching branch of the pre-service teachers was identified as Turkish language teaching corresponding to 13.26% (n=46), mathematics teaching to 12.39% (n=43), primary school teaching to 11.24% (n=39), pre-school teaching to 9.80% (n=34), science teaching and social studies teaching each at 8.93% (n=31), English language teaching and psychological guidance and counseling both at 8.07% (n=28), religious education teaching to 6.34% (n=22), art teaching and special education teaching each at 3.17% (n=11), physical education teaching to 2.31% (n=8), information technologies teaching to 1.44% (n=5), German language teaching and music teaching each at 1.15% (n=4), and finally French and Spanish language teaching each at 0.29% (n=1).

3.3. Research Instrument

The data collection tool used in this study was a questionnaire including two parts: demographics and the "Teaching Materials' Utilization Self-Efficacy Scale" (TMUSES) developed by Korkmaz (2011) to measure pre-service teachers' usage levels of instructional materials based on their perceptions of self-efficacy. The first part of the questionnaire included questions about the demographic background of the respondents such as gender, age, university type, year of study, and teaching branch. In the second part, TMUSES was conducted comprising 23 items in three constructs of message design, usage, and visual design with a five-point Likert-type scale. These factors explained 46.879% of the total variance. In addition, confirmatory factor analysis was also performed, and it was found that the scale had good fit values (RMSEA=0.055, GFI=0.91, CFI=0.97), indicating that the factor structure was confirmed. The stability of the scale was evaluated by the test-retest method, and it was determined that it made consistent measurements over time ($p<0.001$). Regarding the normality and reliability of TMUSES, the kurtosis and skewness values along with reliability coefficients were calculated as depicted in Table 2.

Table 2.
TMUSES Normality and Reliability

TMUSES	Skewness	Kurtosis	Cronbach's Alpha
Message design	-0.388	0.038	0.881
Usage	-0.374	-0.171	0.804
Visual design	-0.571	0.154	0.863

As observed, the kurtosis and skewness values were found between -2 and +2, which confirms the assumption of normal distribution required for the use of parametric tests (George & Mallery, 2010). Concerning reliability, Cronbach's Alpha coefficient was calculated as greater than 0.700, which confirms that the results obtained from the collected data were reliable for all three constructs of TMUSES (Gliem & Gliem, 2003).

3.4. Data Collection

The data was gathered after receiving approval from the Board of Ethics for Human Studies in Social Sciences and Humanities, which ensured that the study adhered to scientific and ethical norms. The questionnaire was set up on an electronic platform and distributed online to over 500 pre-service teachers studying at the faculty of education in different Turkish universities across the country. The participants provided their consent to take in the research voluntarily. After the elimination of the missing responses, 347 valid responses were used for the analyses.

3.5. Data Analysis

All the analyses were performed on SPSS for Windows v27.0 package program. First, descriptive analyses were carried out to investigate the demographic characteristics of the respondents. Second, the normality and reliability were tested for TMUSES. Then, an independent sample t-test was used for variables with two groups including gender, age, and university type, and ANOVA was performed for variables with more than two groups such as year of study and teaching branch. As a result of ANOVA, for the variables that were found to differ between the groups, LSD was used as a post hoc test to determine in which groups there was a difference.

4. Results

4.1. Pre-Service Teachers' Self-Efficacy in TMU

The overall perception of pre-service teachers on their self-efficacy in TMU was identified as high to very high levels (4.184±0.517). The mean scores for the subscales of TMUSES are presented in Table 3 with SD values.

Table 3.
Pre-Service Teachers' Perceptions of TMUSES

TMUSES	$\bar{X}$	SD
Overall Level of TMUSES	4.184	0.517
Message design	4.119	0.567
Usage	4.182	0.572
Visual design	4.252	0.574

As demonstrated, the participants' self-efficacy of message design was found high ($3.41<\bar{X}<4.20$) with a mean score of 4.119±0.567, and their perceptions of self-efficacy of usage were also high ($3.41<\bar{X}<4.20$) with a mean score of 4.182±0.572. Finally, the participants' self-efficacy of visual design was detected as very high ($4.21<\bar{X}<5.00$) with a mean score of 4.252±0.574.

4.2. Variability of Pre-Service Teachers' Self-Efficacy in TMU by Demographic

First, the independent sample t-test was performed to examine the variability of pre-service teachers' self-efficacy in TMU according to gender. As observed in Table 4, pre-service teachers' self-efficacy in message design, usage, and virtual design differed according to gender ($p<0.05$). Accordingly, female pre-service teachers' self-efficacy in message design, usage, and visual design was higher than males. In addition to the significance of these differences, effect size calculations were conducted using Cohen's d to understand the practical significance of these findings. For message design, the effect size demonstrated a small to moderate effect in favor of female pre-service teachers (Cohen's d=-0.392). Regarding usage, the effect size was also identified as a small to moderate effect (Cohen's d=-0.358). As for visual design, the effect size showed a similar magnitude of effect (Cohen's d=-0.395). These values revealed that although the differences were statistically significant, the actual difference in self-efficacy between male and female pre-service teachers was of small to moderate practical importance.

Table 4.
Variability of Pre-Service Teachers' Self-Efficacy in TMU by Gender

TMUSES	Male (n=77)	Female (n=270)	t	p	Cohen's d
Message design	3.948±0.581	4.167±0.554	-2.952	0.004	-0.392
Usage	4.024±0.628	4.227±0.549	-2.569	0.012	-0.358
Visual design	4.078±0.617	4.302±0.552	-2.869	0.005	-0.395

Secondly, the variability of pre-service teachers' self-efficacy in TMU by age was investigated through the independent sample t-test. Before the use of the independent samples t-test, two groups were created by accepting the average age value as the limit value, and the results are listed in Table 5. Accordingly, it was found that pre-service teachers' self-efficacy in message design, usage, and virtual design differed by age ($p<0.05$). Consequently, pre-service teachers who were older than the average age showed higher self-efficacy in message design, usage, and visual design than those who were younger than the average age. Effect size calculations

using Cohen's d further supported these findings. Concerning message design, the effect size indicated a small to moderate effect in favor of the older group (Cohen's d=0.319). For usage, the effect size represented a moderate effect (Cohen's d=0.412). Similarly, regarding visual design, the effect size demonstrated a small to moderate effect (Cohen's d=0.324). These results suggested that while the age-related differences in self-efficacy were statistically significant, they also held moderate practical significance, particularly in the usage domain.

Table 5.
Variability of Pre-Service Teachers' Self-Efficacy in TMU by Age

TMUSES	Above Average (n=103)	Below Average (n=244)	t	p	Cohen's d
Message design	4.245±0.546	4.066±0.568	2.759	0.006	0.319
Usage	4.345±0.548	4.113±0.570	3.558	0.000	0.412
Visual design	4.381±0.527	4.197±0.585	2.876	0.004	0.324

Next, the variability of pre-service teachers' self-efficacy in TMU by university type was examined by using the independent sample t-test. As listed in Table 6, pre-service teachers' self-efficacy in message design, usage, and virtual design differed by the university type they were studying ($p<0.05$). Accordingly, the self-efficacy of the pre-service teachers studying at foundation universities in message design, usage, and visual design was higher than pre-service teachers studying at state universities. To further interpret the practical significance of these findings, Cohen's d was calculated. For message design, the effect size showed a large effect in favor of foundation university students (Cohen's d=-0.784). Regarding usage, the effect size also indicated a large effect (Cohen's d=-0.744). As for visual design, the effect size was detected as a moderate to large effect (Cohen's d=-0.601). These effect sizes revealed that the differences in self-efficacy between students from foundation and state universities were not only statistically significant but also practically meaningful, with foundation university students displaying notably higher self-efficacy.

Table 6.
Variability of Pre-Service Teachers' Self-Efficacy in TMU by University Type

TMUSES	State (n=336)	Foundation (n=11)	t	p	Cohen's d
Message design	4.105±0.566	4.545±0.403	-3.512	0.005	-0.784
Usage	4.168±0.573	4.591±0.404	-3.363	0.006	-0.744
Visual design	4.241±0.574	4.584±0.488	-2.280	0.044	-0.601

Then, the variability of pre-service teachers' self-efficacy in TMU between pre-service teachers in different years of study was investigated through ANOVA. As observed in Table 7, the results indicated no significant differences in self-efficacy on message design, usage, and visual design across the pre-service teachers in different years of study ($p<0.05$). Additionally, the effect sizes (ω^2) were calculated to assess the practical significance of these findings. The effect sizes were found small for message design ($\omega^2=0.013$), usage ($\omega^2=0.009$), and visual design ($\omega^2=0.007$). These small values indicated that the differences in self-efficacy between the groups were minimal, and the year of study accounted for very little variation in self-efficacy. Therefore, in furtherance of the fact that there were no statistically significant differences, the practical differences in self-efficacy between the different years of study were also negligible.

Table 7.
Variability of Pre-Service Teachers' Self-Efficacy in TMU by Year of Study

Year of Study	n	TMUSES		
		Message Design	Usage	Visual Design
1st year	98	3.991±0.630	4.063±0.629	4.159±0.622
2nd year	76	4.124±0.600	4.173±0.588	4.274±0.628
3rd year	59	4.193±0.507	4.260±0.516	4.383±0.476
4th year	91	4.209±0.474	4.256±0.540	4.231±0.539
5th year or more	23	4.100±0.596	4.217±0.478	4.323±0.490
F (p)		2.112 (0.079)	1.759 (0.137)	1.568 (0.182)
ω^2		0.013	0.009	0.007

Finally, the variability of pre-service teachers' self-efficacy in TMU was investigated between the students who were studying at different teaching departments, and the ANOVA results are demonstrated in Table 8.

Table 8.
Variability of Pre-Service Teachers' Self-Efficacy in TMU by Teaching Branch

Teaching Branch	n	TMUSES		
		Message Design	Usage	Visual Design
1. Turkish	46	4.309±0.522	4.380±0.523	4.419±0.505
2. Mathematics	43	3.981±0.547	4.074±0.567	4.056±0.653
3. Primary School	39	4.092±0.473	4.060±0.504	4.179±0.513
4. Pre-School	34	4.350±0.534	4.392±0.549	4.424±0.568
5. Science	31	3.994±0.583	3.995±0.543	4.175±0.466
6. Social Studies	31	4.165±0.585	4.263±0.657	4.406±0.657
7. English	28	4.075±0.535	4.244±0.553	4.240±0.588
8. Psychological Guidance and Counselling	28	4.107±0.464	4.089±0.498	4.224±0.466
9. Religious Education	22	3.977±0.770	4.121±0.600	4.214±0.688
10. Others	45	4.062±0.612	4.148±0.631	4.190±0.564
F (p)		1.953 (0.044)	2.157 (0.025)	1.823 (0.063)
Difference		1-2; 1-5; 1-9; 1-10 2-4; 4-5; 4-9; 4-10	1-2;1-3;1-5;1-8 2-4;3-4;4-5;4-8	
ω^2		0.024	0.029	0.021

Evidently, the ANOVA results revealed significant differences in pre-service teachers' self-efficacy in message design and usage across various teaching branches ($p<0.05$). In the domain of message design, pre-service teachers studying in the department of Turkish language teaching had significantly higher self-efficacy than those in mathematics, science, religious education, and others ($\bar{X}_{Turkish}=4.309$; $p<0.05$) while the pre-service teachers in pre-school teaching showed significantly higher self-efficacy than the ones in mathematics, science, religious education and others ($\bar{X}_{Pre\text{-}school}=4.350$; $p<0.05$). In the domain of usage, pre-service teachers studying Turkish language teaching had significantly higher self-efficacy than those in mathematics, primary school, science, and psychological guidance and counseling ($\bar{X}_{Turkish}=4.380$; $p<0.05$) whereas the pre-service teachers in pre-school teaching demonstrated significantly higher self-efficacy than those in mathematics, primary school, science, and psychological guidance and counseling ($\bar{X}_{Pre\text{-}school}=4.392$; $p<0.05$). On the other hand, it was detected that the pre-service teachers' self-efficacy in visual design did not differ according to the teaching branch ($p>0.05$). The effect sizes were found small for message design ($\omega^2=0.024$), usage ($\omega^2=0.029$), and visual design ($\omega^2=0.021$), suggesting minimal variability in self-efficacy across the different teaching branches. These values indicated that while there were differences, their practical significance was limited.

5. Discussion

Pre-service teachers with elevated self-efficacy in TMU can demonstrate the capacity to create innovative instructional strategies and adeptly utilize a variety of teaching materials to address the diverse needs of their students. Hence, the primary aim of this study was to measure the self-efficacy levels of pre-service teachers in TMU including the key factors of message design, usage, and visual design along with an exploration of the connections between demographic variables and their self-efficacy in TMU. Accordingly, the quantitative analysis of pre-service teachers' self-efficacy in TMU unveiled consistently high levels across all three factors, which aligns with previous research emphasizing the importance of self-efficacy in effective teaching (Asare & Amo, 2023; Ma et al., 2023). Consistently, Bandura's theory on self-efficacy posits that individuals with high self-efficacy tend to approach tasks with confidence and are more likely to succeed (Bandura, 1997). However, the study revealed intriguing variations in self-efficacy levels based on demographic variables across different groups.

In this study, gender became a significant element, with female pre-service teachers demonstrating greater levels of self-efficacy than their male counterparts. The research on gender and the effectiveness of instruction is consistent with the gender disparity in self-efficacy (Kula, 2022; Tshewang et al., 2022). It matters for teacher education programs to comprehend gender dynamics in order to tailor training and support to the unique requirements of pre-service teachers, both male and female. Nevertheless, it should be noted that the majority of the sample consisted of female pre-service teachers, which may be regarded as a limitation for the lack of equal representation of gender.

The study additionally explored age as a demographic factor, and it was revealed that age had a significant impact on the self-efficacy levels of pre-service teachers. The findings supported the notion of age-related experience and confidence development as older individuals exhibited greater levels of self-efficacy (Kang Ma & Mcmaugh, 2022; Tschannen-Moran et al., 1998). The aforementioned discovery underscores the necessity for teacher education programs to acknowledge the possible influence of age on the growth of self-efficacy regarding the utilization of materials for instruction.

In relation to the differences in pre-service teachers' levels of self-efficacy between foundation and state universities, it was found that those from foundation universities had higher levels of self-efficacy at TMU than those from state universities. Differences in the curricula, available resources, or instructional strategies between the two kinds of institutions might be the cause of this disparity (Ingersoll & Strong, 2011). These findings highlight the need to take institutional context into account when designing programs for teacher education. However, it is notable that a significant majority of the sample was studying at state universities whereas only a smaller fraction was at foundation universities, which indicates a limited representation of pre-service teachers from foundation universities.

Although age and gender were found to have an impact on self-efficacy, no significant differences emerged across the year of study, which suggests that self-efficacy in TMU among pre-service teachers remains relatively stable throughout their academic progression. However, interesting differences were observed between the different branches of teaching, particularly in message design and usage. Because message structure provides a link between low-level conversational components and high-level strategic goals (Gibbons & Boling, 2021), pre-service teachers in different teaching streams may think about message design differently. Although the effective use of instructional materials in the classroom affects student learning outcomes (Guerrettaz et al., 2022; Harwood, 2021; Krajcik & Delen, 2017), the use of materials in different branches of teaching may vary depending on the type of instruction in different disciplines. The lack of significant differences in visual design may indicate a potential area of

regularity in self-efficacy levels across different teaching disciplines. These results clearly depict the variations of pre-service teachers' self-efficacy by demographic variables and contribute to tailoring teaching materials competencies of pre-service teachers in specific branches (Tschannen-Moran & Woolfolk Hoy, 2007). Furthermore, the observed variations within teaching branches identified that the diversity of teaching fields necessitates targeted support in specific areas, such as message design and usage, to equip pre-teachers with the skills they need to cater to the specific requirements of different teaching specialties (Klassen et al., 2011).

To summarize, the observed differences based on gender, age, university attended, and teaching field offer valuable insights for educators and policymakers in establishing more focused and successful teacher training initiatives. Therefore, it is essential to take these results into account when cultivating a skilled group of pre-service teachers equipped to navigate the challenges of educational settings at TMU.

6. Conclusion

This study explored the level of self-efficacy among pre-service teachers at TMU in relation to message design, usage, and visual design as well as their correlation with demographic factors. The results provide significant outcomes for teacher education programs. When creating successful training interventions, educators should recognize and address TMU elements and differences in self-efficacy based on demographics among pre-service teachers. Tailoring support mechanisms based on gender, age, institutional background, and teaching branch can enhance the overall efficacy of teacher education programs; consequently, this supports the broader goal of teacher education in preparing future educators for the multifaceted demands of the teaching profession (Houston & Hood, 2017). Among pre-service teachers with high self-efficacy in TMU, it is clear that they will be able to manifest their ability to develop innovative instructional strategies and successfully use numerous teaching aids that facilitate solving various learning problems among their students (Asare & Amo, 2023; Ma et al., 2023). Briefly, fostering high self-efficacy in TMU among pre-service teachers not only enhances their instructional effectiveness but also contributes to creating inclusive and engaging learning environments that promote student success.

7. Recommendations

The results of the present study uncovered several practical implications. First, depending on demographic characteristics, teacher education programs should provide pre-service teachers with particular interventions and support systems to address their specific needs (Kula, 2022; Tshewang et al., 2022). A variety of support strategies are likely to be practices from real life that could help improve the self-efficacy levels among pre-service teachers in TMU. For example, male pre-service teachers' self-efficacy can be fostered through special project designs in TMU addressing their real-life needs, and younger pre-service teachers may be offered more focused courses on TMU.

Additionally, it is a call for teacher education programs to assess their curricula and update them with TMU competence-centered modules (Gibbons & Boling, 2021; Guerrettaz et al., 2022). The curricula that these programs should integrate must incorporate instructional message design, usage, and visual design techniques, and also ways in which different learning preferences of students can be met through resource customization. Particularly, as evident from the results of this study, pre-service teachers' self-efficacy in TMU varied by their teaching branch; therefore, each department should consider the integration of instructional

techniques for message design, usage, and visual design into their curricular components in terms of the field-specific requirements.

Finally, pre-service teachers, educators, researchers, and professionals with diverse perspectives should promote their cooperation and networking on sharing best practices as well as joint work on the improvement of TMU competencies and educational outcomes. This kind of cooperation and networking should be provided within and among the departments of different teaching branches.

8. Limitations

There are some potential limitations of the present study that suggest directions for the areas for further research. First, the research sample may have interfered with the study's conclusions in terms of its representativeness. Due to sample bias arising from the convenience sampling method, the generalizability of the results might be limited. For example, the sample exhibited a notable gender imbalance, with just under one-quarter of pre-service teachers being male and 78% of the participants being female. This kind of distribution by gender may underrepresent the perspectives of male pre-service teachers at TMU. Therefore, a more balanced gender distribution should be provided in future studies to obtain a broader understanding of self-efficacy across all demographics.

Another limitation resulting from the characteristics of the sample can be the disproportionate representation of state (97%) and foundation universities (3%). Because the participants were overwhelmingly from state universities, the generalizability of the findings related to university type can be questioned. Particularly, state and foundation universities in Turkey have different resources, teaching philosophies, and training environments. These differences combined with limited representation in this study could influence the findings about pre-service teachers' self-efficacy in TMU. Accordingly, future research should attempt to include a more proportionate sample from foundation universities to provide a more comprehensive understanding of self-efficacy across different types of educational institutions.

Furthermore, the sample size varied across teaching branches, which could impact the study's statistical power. For instance, branches with smaller sample sizes may not provide enough data to draw meaningful conclusions about specific areas of teacher self-efficacy. This variability can lead to potential biases between branches. Thus, future studies should aim to reach more balanced sample sizes across teaching branches to ensure significant branch-specific insights.

Additionally, the geographical distribution of the participants within Turkey could also have influenced the findings. Because of the convenience sampling method, the geographical characteristics were ignored in this study. However, Turkey has diverse socio-cultural and educational contexts across its regions, which may affect pre-service teachers' experiences and their self-efficacy in utilizing teaching materials. Different regions of the country may represent varied contextual backgrounds and access to resources, which could influence pre-service teachers' experiences and perspectives. Hence, the inclusion of participants from various regions across the country should be considered in future studies to capture the potential influence of geographical and cultural contexts on pre-service teacher training.

Overall, several limitations concerning the sample were indicated as gender imbalance, underrepresentation of university types, varied sample sizes in teaching branches, and lack of geographical diversity. These demographic factors should be taken into account in future studies to obtain more generalizable results in this field. Other sampling methods can be

selected in further research such as purposive sampling distinct from the sampling method used in this study.

In addition to the limitations of sample representation, another issue observed in relation to this study could be that the results relied on self-reporting measures to gauge individuals' self-efficacy levels in TMU. Self-reporting indicators may be subject to respondent interpretation or social desirability bias, which might affect the accuracy of self-efficacy evaluations. Accordingly, it is recommended that future studies should adopt different methodologies to overcome the drawbacks associated with self-reporting measures such as mixed-method designs. It would be also beneficial to consider contextual factors with longitudinal designs in future studies on TMU.

Ethics Statements

This study received permission for scientific and ethical compliance from the Istanbul Technical University Board of Ethics for Human Studies in Social Sciences and Humanities (documented on 25.12.2023; project no: 438).

Conflict of Interest

The author has no conflict of interest to declare.

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