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SELF-EFFICACY PERCEPTIONS OF ELEMENTARY MATHEMATICS TEACHER CANDIDATES REGARDING DIFFERENTIATED INSTRUCTION

(Research article)

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Abstract

The aim of this study is to examine the self-efficacy perceptions of pre-service elementary mathematics teachers regarding differentiated instruction. The research was designed within the framework of the survey model, one of the quantitative research methods. The study sample consisted of 209 pre-service mathematics teachers enrolled in an undergraduate elementary mathematics teacher education program at a public university in Turkey. Data were collected through the "Differentiated Instruction Self-Efficacy Scale," which has established validity and reliability in the literature, along with a demographic information form. The findings revealed that pre-service teachers generally had moderate-to-high levels of self-efficacy regarding differentiated instruction. While no statistically significant differences were found based on gender, significant differences emerged in relation to the year of study. In particular, fourth-year pre-service teachers demonstrated higher levels of self-efficacy in the dimensions of planning, implementation, and assessment. This suggests that as teacher candidates gain more professional experience and opportunities to engage in instructional practice, their perceived competence in differentiated instruction tends to increase. The results highlight the importance of integrating applied experiences related to differentiated instruction into teacher education programs, particularly during the early stages of professional training.

Keywords: Differentiated instruction; self-efficacy; pre-service teachers; mathematics education

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1. Introduction

Our distinct characteristics, interests, living environments, types of intelligence, ways of learning and perceiving the world, abilities, and many other factors are the elements that shape us as individuals. Just like fingerprints, each individual brings a unique set of personal traits and differences into the teaching–learning process. These individual differences include learning priorities and experiences, prior knowledge, readiness levels, learning profiles and styles, areas of interest, and learning speeds. According to Tomlinson and Imbeau (2013), possessing different characteristics is inherent to human nature, and effective teachers are those who take their students' differences into account while planning and organizing instruction. These characteristics significantly influence students' learning needs (Mutlu & Öztürk, 2017). Therefore, it does not seem realistic to expect students to benefit equally from a one-size-fits-all teaching process. In this regard, addressing students' individual learning needs requires differentiating the instructional process by taking their unique characteristics into account (Kontaş, 2012; Smutny, 2003). At this point, the approach of differentiated instruction emerges, which acknowledges each student as a unique learner based on their individual characteristics, differences, and how they learn (Algozzine & Anderson, 2007).

Differentiated instruction can be described as a conceptual and practical framework that reflects teachers' efforts to create learning environments responsive to individual differences. At its simplest, differentiated instruction refers to the effort to address students' needs and provide varied learning experiences by taking individual differences into account throughout the instructional process (Tomlinson, 2014). Since learning experiences are designed according to students' needs within this approach, it fosters meaningful engagement and active participation from learners (Chapman & King, 2013). Consequently, how students learn, how they engage in learning, and how they apply what they learn in everyday life become crucial considerations (Tomlinson, 2014). Heacox (2002) defines differentiated instruction as the adaptation of the instructional process based on individual interests, preferences, needs, and learning profiles. According to Campbell (2008), differentiated instruction is not merely a strategy, method, or technique but rather a comprehensive approach that encompasses intentional modifications and applications in teaching. Similarly, Gregory and Chapman (2014) conceptualize differentiated instruction as a philosophy or perspective that enables teachers to design instruction with the goal of helping students achieve specific learning outcomes. In this sense, differentiated instruction requires that content, process, product, and the learning environment be planned, adapted, and differentiated in accordance with students' readiness levels, interests, and learning profiles (Gregory & Chapman, 2012; Tomlinson, 2001).

The entirety of knowledge, skills, attitudes, and behaviors that students need to acquire in order to achieve learning outcomes is referred to as content. Content differentiation can be achieved by emphasizing the core concepts, processes, and skills of a subject or by adjusting the level of complexity (Demir, 2013). Examples of differentiated content include the use of texts at varying levels, a combination of auditory and visual materials, working with diverse resources, and engaging in small group instruction using varied content tailored to students who

require additional support. The term process refers to the set of activities through which students engage with the content and acquire skills or concepts (Tomlinson, 2014). In essence, the process represents the pathway by which students access and internalize knowledge. Differentiation of the process involves addressing the question of "how" learning occurs by diversifying teaching methods, materials, and digital tools to suit students' needs (Tomlinson, 2014). The product, on the other hand, consists of the knowledge, skills, and actions that reflect students' learning outcomes. In other words, the product encompasses the full demonstration of what has been learned. Product differentiation can be supported by offering students multiple options to express their learning, allowing them to choose how they demonstrate understanding, and giving them autonomy over their own work (Tomlinson, 2014). Differentiating the learning environment involves designing physical and emotional classroom spaces in ways that facilitate collaboration between students and teachers and foster shared learning experiences (Tomlinson, 2001).

Teachers play a critical role in achieving the intended goals of differentiating the four dimensions mentioned above (Finley, 2008). They are the key agents capable of implementing the abstract concept of differentiation in the classroom by making necessary adjustments based on students' individual needs, monitoring their learning processes, and shaping instruction accordingly (Tomlinson & Imbeau, 2010; Dixon et al., 2014). In this sense, differentiation is not only about what students learn but also about how teachers teach. Therefore, it can be stated that teachers have a decisive role and active responsibility in planning and adapting every component of differentiated instruction—namely content, process, and product (Fox & Hoffman, 2011). Teachers who apply differentiated instruction in their classrooms are expected to possess different qualities and responsibilities compared to those working in more traditional teaching environments. Tomlinson (2014) offered several suggestions for teachers seeking to implement differentiated instruction effectively. These include: (a) teachers first feeling mentally ready to embrace differentiation; (b) continuously reflecting on the alignment between their educational philosophy and classroom practices; (c) envisioning how they want their classroom to function and planning accordingly; (d) informing and involving stakeholders in the differentiation process; (e) implementing differentiation gradually and through consistent routines; and (f) regularly reviewing routines and classroom practices to ensure alignment and effectiveness.

In today's world, changing perspectives on the nature of mathematics as a discipline have led to a transformation in the goals and approaches of mathematics education. Accordingly, the primary aim of mathematics instruction has shifted toward enabling students to develop a deep understanding of mathematical concepts and to apply them in real-life contexts. In this regard, it can be asserted that teachers' knowledge, skills, attitudes, and competencies related to mathematics instruction play a critical role in students' ability to comprehend mathematics and use it in everyday situations (Campbell et al., 2014; Copur-Gencturk, 2015; Kaskens et al., 2020; König et al., 2021). Therefore, there is a clear need not only to enhance teachers' mathematical knowledge but also to improve their instructional competencies (Hiebert et al., 2003). In

particular, providing competency-based training to teacher candidates positively affects their self-efficacy (Karani et al., 2021). In mathematics teaching, providing learning opportunities that are responsive to individual differences facilitates the learning of abstract mathematical concepts and increases student engagement (Ünver & Demirtaşlı, 2021). It is also effective in fostering and developing core mathematical skills such as problem-solving, reasoning, making connections, and communication, which are among the fundamental aims of mathematics education. A number of national and international studies have focused on the effectiveness of differentiated instruction in mathematics education (Awofala & Lawani, 2020; Delice, 2019; Ekinci & Bal, 2019; Good, 2006; Lai et al., 2020; Muthomi et al., 2014; Şaldırak, 2012; Prast, 2018). Taken together, these studies suggest that adopting differentiated instruction in mathematics education represents a holistic approach that not only improves academic achievement but also enhances students' interest in the learning process and the retention of knowledge.

In the Türkiye Century Maarif Model, differentiated instruction has been addressed for the first time as an overarching concept within the context of a holistic educational approach. The model emphasizes that teachers should adopt an instructional process that highlights students' individual differences, flexible grouping, continuous assessment, and adaptive teaching practices (MoNE, 2024). Under the "Differentiation" heading of the Türkiye Century Maarif Model, it is expected that teachers will become aware of this innovative instructional approach and willingly embrace and support it. For teachers to implement differentiated instruction effectively, it is considered essential that they develop awareness and a sense of self-efficacy during the pre-service training period. Revealing pre-service teachers' perspectives on differentiated instruction may serve as a guide for both practitioners in the field and educational researchers. Therefore, instilling differentiated instruction as a pedagogical mindset should begin during pre-service education. Determining the self-efficacy levels of pre-service elementary mathematics teachers regarding differentiated instruction is of great importance for ensuring the effective implementation of differentiation in mathematics teaching. Although there are studies in Türkiye examining the self-efficacy perceptions of pre-service teachers enrolled in early childhood education, primary education, science education, and social studies education programs (Aşiroğlu, 2016; Gedik et al., 2023; Koç & Şensoy, 2025; Karadağ, 2014; Üçarkuş & Yeşilbursa, 2020; Zoraloğlu, 2022), no studies have been found in the national literature that specifically focus on pre-service elementary mathematics teachers. Investigating the perceptions of these teacher candidates regarding differentiated instruction can contribute significantly to improving both teacher education programs and the effectiveness of classroom practices. The overall aim of this study is to determine the self-efficacy perceptions of pre-service elementary mathematics teachers regarding differentiated instruction. In line with this objective, the study seeks to answer the following research questions:

1. What are the self-efficacy levels of pre-service mathematics teachers regarding differentiated instruction?

2. Is there a significant difference in pre-service elementary mathematics teachers' self-efficacy levels in the subdimensions of planning, implementation, and assessment with respect to gender?
3. Is there a significant difference in pre-service elementary mathematics teachers' self-efficacy levels in the subdimensions of planning, implementation, and assessment with respect to heir year of study?

2. Method

2.1. Research Design

This study was conducted based on the descriptive survey design, which is one of the quantitative research methods. Since the aim of the study was to determine the existing self-efficacy levels of pre-service elementary mathematics teachers, the survey design was deemed appropriate. Research based on survey designs aims to describe various characteristics of a sample selected from a defined population by collecting data from that sample (Fraenkel, Wallen, & Hyun, 2011).

2.2. Participant (subject) characteristics

The participants of the study consisted of 209 pre-service teachers enrolled in the Elementary Mathematics Teacher Education undergraduate program at a public university located in Gaziantep, Türkiye. The sample included students from all year levels of the program. Convenience sampling was used to determine the participants. This sampling method was chosen because it allowed easier access to participants and because the participants were relatively more willing to take part in the study (Johnson & Christensen, 2014). The study examined the participants' general self-efficacy perceptions regarding differentiated instruction in relation to their year of study and gender. Efforts were made to ensure a balanced number of participants from each year level. The distribution of participants by year level is presented in Figure 1, and their distribution by gender is shown in Figure 2.

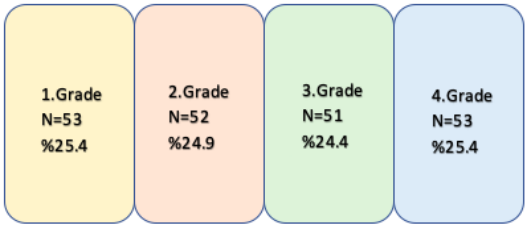


Figure 1. Participant distribution by grade

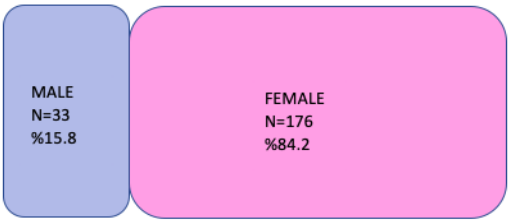


Figure 2. Participant distribution by gender

As shown in Figure 1, 25.4% (N = 53) of the participants were first-year students; 24.9% (N = 52) were in their second year; 24.4% (N = 51) were in their third year; and 25.4% (N = 53) were

in their fourth year of study. Additionally, according to Figure 2, 84.2% (N = 176) of the participants were female, while 15.8% (N = 33) were male pre-service teachers.

2.3. Data Collection

The data for the study were collected during the spring semester of the 2024–2025 academic year. The data collection instrument was administered to pre-service elementary mathematics teachers enrolled in the faculty of education at a public university in Gaziantep, Türkiye. During the data collection process, participant information was kept confidential, and participation was based on voluntary consent. The research was conducted in accordance with ethical principles and guidelines.

2.4. Data Collection Instruments

In this study, to determine the self-efficacy perceptions of pre-service teachers regarding differentiated instruction, the "Differentiated Instruction Self-Efficacy Scale" developed by Mutlu, Öztürk, and Aktekin (2019), which has been validated and proven reliable in the literature, was utilized. In addition to the scale, a demographic information form prepared by the researchers, including data on participants' year of study and gender, was also administered. The self-efficacy scale was applied in the classroom under supervision, and all participants completed the forms voluntarily. The developers of the scale initially conducted an exploratory factor analysis (EFA) and identified a three-factor structure consisting of 26 items. A subsequent factor analysis confirmed this structure and revealed that the model explained 56.57% of the total variance. Reliability analysis for the sub-dimensions of the scale was conducted using internal consistency, and Cronbach's alpha coefficients were calculated. Accordingly, the reliability coefficient was found to be 0.91 for the first sub-dimension (Planning), 0.90 for the second (Implementation), and 0.87 for the third (Assessment). The overall Cronbach's alpha coefficient for the entire scale was 0.95, indicating that the scale has a high level of reliability both overall and within its sub-dimensions. The total scores that can be obtained from the scale range from a minimum of 26 to a maximum of 130. Since the scale does not contain any reverse-coded items, no transformation is required during the scoring process.

2.5. Data Analysis

The data obtained were analyzed using the SPSS 26 statistical software package. The analysis process was carried out based on the responses of 209 pre-service elementary mathematics teachers who participated in the study. In order to determine the self-efficacy levels of the participants regarding differentiated instruction, arithmetic mean and standard deviation values were utilized. For interpreting the arithmetic means, the following ranges were used: 1.00–1.80 = "strongly disagree," 1.81–2.60 = "disagree," 2.61–3.40 = "somewhat agree," 3.41–4.20 = "agree" and 4.21–5.00 = "strongly agree". For the gender variable examined in the study,

an independent samples t-test was conducted, while a one-way analysis of variance (ANOVA) was employed to compare the self-efficacy levels across different year levels. The research findings were presented based on the results of these analyses.

3. Results

As a result of the data analysis, the self-efficacy levels of pre-service elementary mathematics teachers regarding differentiated instruction were evaluated based on both the total scores obtained from the scale and the scores from its sub-dimensions. In this context, the data were presented in tabular form with respect to both gender and year of study variables.

In the first part of the analysis, pre-service elementary mathematics teachers' self-efficacy perceptions related to differentiated instruction were examined under three sub-dimensions: planning, implementation, and assessment. The arithmetic means and standard deviations of the responses to the items in each sub-dimension are presented in Table 1.

Table 1. Mean and Standard Deviation Scores of Pre-Service Elementary Mathematics Teachers' Self-Efficacy Levels Regarding Differentiated Instruction

Dimensions	*N*	*X*	*ss*	Level
Planning	209	3.53	.92	Medium-High
Implementation	209	3.54	.90	Medium-High
Evaluation	209	3.56	.92	Medium-High
Overall Self-Efficacy Level	209	3.54	.90	Medium-High

An examination of Table 1 reveals that pre-service elementary mathematics teachers' general self-efficacy perceptions regarding differentiated instruction, as well as their scores across the sub-dimensions, are at a moderate-to-high level. The mean scores related to the planning dimension range from 3.39 to 3.75. The highest average was found for the item *"I can prepare activities for the lesson based on students' interests."* ($\bar{x}$ = 3.75, SD = 0.95). The lowest average was observed for the item *"I can create instructional materials at different levels for students with varying prior knowledge."*($\bar{x}$ = 3.39, SD = 0.99). The overall mean score for the planning dimension was 3.53, indicating a moderate-to-high level of perceived competence among teacher candidates in this area.

In the implementation dimension, the mean scores ranged from 3.42 to 3.68. The item with the highest self-efficacy perception was *"I can use class time flexibly based on students' learning pace."* ($\bar{x}$ = 3.68, SD = 0.87), while the lowest was *"I can create learning stations for students with different learning styles."* ($\bar{x}$ = 3.42, SD = 0.95). The overall mean for this dimension was 3.54, suggesting that participants perceive themselves as moderately to highly competent in implementing differentiated instruction.

For the assessment dimension, the mean scores varied between 3.44 and 3.68. The item with the highest average score was *"I can provide feedback to students with different characteristics*

based on their needs." ($\bar{x}$ = 3.68, SD = 0.85), whereas the lowest was *"I can differentiate questions in written and standardized tests."* ($\bar{x}$ = 3.44, SD = 0.96). The mean score for the assessment dimension was 3.56, indicating that teacher candidates hold a generally positive perception of their competence in differentiated assessment practices.

Additionally, the overall self-efficacy perception score for differentiated instruction, calculated from all 26 items of the scale, was $\bar{x}$ = 3.54. This finding suggests that participants generally perceive themselves as moderately to highly competent in implementing differentiated instruction practices.

The results of the t-test comparing the self-efficacy scores of pre-service elementary mathematics teachers by gender are presented in Table 2.

Table 2. T-Test Results of Pre-Service Elementary Mathematics Teachers' Self-Efficacy Levels Regarding Differentiated Instruction According to Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean	Sig.	t
Planning	Male	33	35.515	9.193	1.600	0.077	0.102
	Female	176	35.369	7.210	.5435		
Implementation	Male	33	38.788	8.245	1.435	0.616	-0.172
	Female	176	39.040	7.594	0.5724		
Evaluation	Male	33	17.788	4.174	0.7266	0.48	-0.049
	Female	176	17.824	3.83	0.2887		
Total	Male	33	92.091	20.815	3.623	0.184	-0.042
	Female	176	92.233	17.468	1.317		

In the study, when the self-efficacy perceptions of pre-service teachers regarding differentiated instruction were examined in relation to the gender variable, no statistically significant differences were found between male and female participants in the sub-dimensions of planning, implementation, and assessment, nor in the overall scores. The results of the analysis revealed the following values: planning ($p = .077$, $t = .102$); implementation ($p = .616$, $t = -0.172$); assessment ($p = .480$, $t = -0.049$); and total score ($p = .184$, $t = -0.042$). As all p-values were above the .05 significance threshold, it can be concluded that gender does not have a statistically significant effect on self-efficacy perceptions. The mean scores obtained in all three sub-dimensions and in the total score were quite similar for both groups, further supporting the finding that gender is not a determining factor in perceived self-efficacy. The results of the ANOVA test conducted to examine the self-efficacy levels of pre-service elementary mathematics teachers according to year of study are presented in Table 3.

Table 3. ANOVA Results of Pre-Service Elementary Mathematics Teachers' Self-Efficacy Levels Regarding Differentiated Instruction According to Year of Study

	Grade Level	N	Mean	Std. Deviation	F	LSD
Planning	1st Grade	53	34.5849	8.05136	5.96	4th Grade> 1st, 2nd, 3rd Grade; 3rd Grade> 2nd Grade
	2nd Grade	52	32.75	8.00459		
	3rd Grade	51	35.5882	5.51789		
	4th Grade	53	38.6038	7.19866		
Implementation	1st Grade	53	37.8491	8.45212	7.41	4th Grade> 1st, 2nd, 3rd Grade; 3rd Grade> 2nd Grade
	2nd Grade	52	36.1923	7.79401		
	3rd Grade	51	39.2353	6.31692		
	4th Grade	53	42.6792	6.59479		
Evaluation	1st Grade	53	17.1887	4.04331	6.7	4th Grade> 1st, 2nd, 3rd Grade; 3rd Grade> 2nd Grade
	2nd Grade	52	16.4231	3.87726		
	3rd Grade	51	18.1373	2.94632		
	4th Grade	53	19.5094	3.91065		
Total	1st Grade	53	89.6226	19.31841	7.59	
	2nd Grade	52	85.3654	18.65163		
	3rd Grade	51	92.9608	13.60435		
	4th Grade	53	100.7925	16.49051		

A one-way analysis of variance (ANOVA) was conducted to determine whether the self-efficacy perceptions of pre-service teachers regarding differentiated instruction differed significantly according to their year of study. The results presented in Table 3 indicate that there were statistically significant differences based on year level in all three sub-dimensions planning ($F(3, 205) = 5.956$, $p = .001$), implementation ($F(3, 205) = 7.410$, $p < .001$), and assessment ($F(3, 205) = 6.699$, $p < .001$) as well as in the overall self-efficacy score ($F(3, 205) = 7.589$, $p < .001$). These results demonstrate that pre-service teachers' self-efficacy perceptions regarding differentiated instruction vary significantly depending on their year of study. Following the one-way analysis of variance, LSD post-hoc comparisons were conducted to determine between which year levels the differences occurred and in which direction. In

the planning sub-dimension, fourth-year students had significantly higher self-efficacy perceptions than first-, second-, and third-year students ($p < .05$). Additionally, third-year students scored significantly higher than second-year students ($p = .049$). In the implementation sub-dimension, fourth-year students had significantly higher scores than all other year groups ($p < .05$). Moreover, third-year students demonstrated significantly higher self-efficacy than second-year students ($p = .037$). A similar pattern was observed in the assessment sub-dimension: fourth-year students scored significantly higher than second-year students ($p < .01$), and a significant difference was also found between third- and second-year students ($p = .021$). Regarding the overall self-efficacy score, fourth-year students had significantly higher scores compared to first- and third-year students ($p < .05$). In addition, third-year students scored significantly higher than second-year students ($p = .026$). Overall, these findings indicate that as year of study increases, pre-service teachers' self-efficacy perceptions regarding differentiated instruction also tend to increase. Notably, fourth-year students differed significantly from other year levels across all sub-dimensions and in the total score, suggesting that pre-service teachers' competencies in differentiated instruction improve alongside their professional development.

4. Discussion

One of the primary objectives of this study was to determine the self-efficacy levels of prospective elementary mathematics teachers regarding differentiated instruction practices. Within the scope of the research findings, the self-efficacy perceptions of prospective elementary mathematics teachers toward differentiated instruction were examined based on the dimensions of planning, implementation, and assessment. The study is based solely on a scale measuring self-efficacy perceptions. These perceptions may not fully reflect the participants' actual competencies in real classroom practices. The focus exclusively on self-efficacy perceptions, along with the inclusion of only prospective elementary mathematics teachers as participants, can be considered a potential limitation of this research. The results indicated that both the general self-efficacy perceptions and the competencies related to the sub-dimensions were at a moderate-to-high level. This suggests that prospective teachers possess a certain level of awareness and a sense of competence in planning, implementing, and assessing instruction while considering individual differences. This finding aligns with the assertions of Tomlinson (2014) and Gregory and Chapman (2012), who emphasize the responsibility of teachers to design learning environments that are sensitive to individual differences. Similarly, studies conducted by Awofala and Lawani (2020) and Prast (2018) reported that teachers' attitudes toward differentiated instruction and their self-efficacy perceptions were at a moderate-to-high level. In research conducted by Dack (2019) with prospective elementary mathematics teachers, it was found that the ability of teacher candidates to meet students' mathematical needs significantly improved through differentiated instruction training within guided mathematics frameworks. Chamberlin (2011) examined how prospective teachers experienced differentiated

instruction in mathematics education courses, whether it addressed diverse instructional needs, and how it might influence their future mathematics teaching. The results revealed that teacher candidates found differentiated instruction supportive of various needs and planned to apply similar strategies in their future teaching. Following a study with STEM teacher candidates, Estaiteyeh and Decoito (2023) highlighted the importance of integrating differentiated instruction in mathematics and science courses, emphasizing that teacher education programs should include content related to differentiated instruction.

National literature also supports these findings. Research conducted by Ekinci and Bal (2019) and Delice (2019) indicated that prospective teachers exhibit positive attitudes toward differentiated instruction approaches and feel confident in applying them. Furthermore, Aydoğan Yenmez and Özpınar (2017) reported that prospective elementary mathematics teachers implemented practices in their lesson planning process according to the design principles of differentiated instruction, thereby gaining awareness and a perspective toward this pedagogical approach. Similarly, Doğan and Avcıoğlu (2024) investigated the effect of riddles in differentiated mathematics teaching at the primary school level, finding that such activities positively influenced students' interest in mathematics, enhanced the permanence and effectiveness of learning, encouraged creative thinking, and supported conceptual understanding. Karakaş (2019) also found that differentiated instruction in mathematics increased students' engagement, interest, and confidence; improved individual and group work skills; enhanced social interaction and learning responsibility; and positively contributed to each student's level. Additionally, product-process assessment and subsequent lesson planning were reported to become more effective through the implementation of differentiated practices.

Accordingly, it can be stated that incorporating differentiated instruction activities in mathematics teaching is crucial. Integrating this approach into teacher education programs during the pre-service period can raise prospective teachers' awareness and enhance their competencies in differentiated instruction. Pozas et al. (2019) emphasized that mathematics teachers' belief levels have a strong influence on their differentiated instruction practices, indicating the importance of developing these beliefs during the pre-service period.

In this context, the findings of the current study are consistent with both national and international literature. Tomlinson (2014) and Heacox (2002) underline the importance of a teacher's ability to plan and adapt instruction according to students' individual needs for the success of differentiated instruction. Thus, it can be inferred that prospective teachers are developing both cognitive and affective awareness in light of this pedagogical approach. However, in order for this self-efficacy perception to be sustainably reflected in practice, teacher education programs should provide more systematic and structured experiences that allow the transition from theory to practice (Gregory & Chapman, 2021). In this way, teacher candidates' self-efficacy beliefs can evolve from an abstract conceptual level to concrete instructional practices.

The findings of the study indicate that there is no statistically significant difference in prospective elementary mathematics teachers' self-efficacy perceptions toward differentiated

instruction based on gender. It was reported that 84.2% of the participants were female and 15.8% were male. The lack of a significant gender-based difference may be due to the potential impact of such a large numerical imbalance between the groups on statistical power. The close similarity in the mean scores of female and male participants across the sub-dimensions of planning, implementation, and assessment suggests that gender is not a determining factor in pedagogical competence. This finding aligns with the studies of Gedik et al. (2023) and Üçarkuş and Yeşilbursa (2020), which similarly reported that self-efficacy perceptions toward differentiated instruction are shaped independently of gender. Although Aşıroğlu (2016) observed that female teacher candidates scored higher in some sub-dimensions, it was noted that these differences were not generalizable. These results suggest that competencies in differentiated instruction may be more closely associated with individual-professional development factors such as pedagogical knowledge, experience gained through teaching practice, and awareness of learning processes. Examining studies with divergent findings, Prast (2018) proposed that female teachers might be more sensitive to students' individual differences, whereas studies by Karadağ (2014) and Koç and Şensoy (2025) did not identify significant gender-based differences, supporting the view that pedagogical competencies related to differentiated instruction develop through professional experience and pedagogical interactions rather than societal gender roles. In this context, it can be argued that the primary determinants of prospective teachers' self-efficacy perceptions toward differentiated instruction are individual instructional experiences, program content, and learning opportunities. Therefore, teacher education processes should prioritize content quality, equitable access to opportunities, and practice-oriented experiences over gender differences. This approach suggests that gender can be considered a neutral variable in the development of pedagogical competencies, with the structural and functional quality of education serving as the principal determinant.

Another noteworthy finding of the study is that prospective elementary mathematics teachers' self-efficacy perceptions toward differentiated instruction varied significantly according to their grade levels. In particular, teacher candidates at the 4th-grade level scored significantly higher in both the sub-dimensions of planning, implementation, and assessment as well as in the overall score. This suggests that candidates at this level have matured more in terms of professional knowledge and experience. Similarly, the observation that 3rd-grade students scored higher in self-efficacy than 2nd-grade students indicates that this development is gradual and continuous. Tomlinson and Imbeau (2010), as well as Dixon et al. (2014), emphasize that in order for teachers to implement differentiation effectively, they need not only theoretical knowledge but also practical skills based on classroom experiences. Findings by Muthomi et al. (2014) further indicate that as teachers' levels of experience increase, their tendencies and competence in implementing differentiation also improve. In a study conducted by Koç and Şensoy (2025) with prospective science teachers, grade level was also identified as a determining factor in self-efficacy perceptions toward differentiated instruction. This suggests that as teacher candidates progress through their undergraduate programs, they structure their pedagogical competencies more systematically. These findings are also consistent with the framework of social cognitive theory, which posits that teacher competencies develop over time (Bandura, 1997; Tschannen-

Moran & Hoy, 2001). According to this theoretical perspective, self-efficacy perception is based not only on theoretical knowledge but also on the sense of accomplishment and opportunities for practice gained through experience. Indeed, developing competence in complex and adaptable pedagogical approaches such as differentiated instruction is closely related to experience-based learning processes, including observation, micro-teaching, mentoring, and classroom practice. Supporting this view, Ekinci and Bal (2019) indicate that such practices are effective in enhancing prospective teachers' skills in strategy development and individualizing instruction.

5. Conclusions and Recommendations

This study examined prospective elementary mathematics teachers' self-efficacy perceptions toward differentiated instruction, focusing on the dimensions of planning, implementation, and assessment. The findings indicate that, overall, teacher candidates' self-efficacy perceptions in the sub-dimensions of planning, implementation, and assessment were above average. Accordingly, it can be suggested that prospective teachers possess a certain level of awareness regarding the integration of support and enrichment activities in mathematics instruction while considering individual differences. These findings are consistent with both national and international literature, supporting the notion that teacher candidates have positive attitudes and self-efficacy perceptions toward the differentiated instruction approach.

Another important finding is that there were no significant gender differences in self-efficacy perceptions toward differentiated instruction. This result suggests that pedagogical competence is more closely associated with individual teaching experiences, program content, and learning opportunities than with societal gender roles. Therefore, offering all candidates practice-oriented experiences based on equal opportunities plays a more decisive role in teacher education programs.

Furthermore, a significant finding is that prospective teachers' self-efficacy perceptions toward differentiated instruction increased with grade level. Specifically, teacher candidates in higher grades scored higher on both the overall scale and the sub-dimensions, indicating that competencies develop through the interaction of theoretical knowledge and experiential learning. As predicted by social cognitive theory, practical experiences and a sense of accomplishment play a crucial role in strengthening self-efficacy perceptions. Consequently, this study demonstrates that prospective teachers develop awareness of differentiated instruction and that this awareness strengthens as they advance in their programs. However, for this self-efficacy perception to be effectively and sustainably translated into classroom practices, pre-service teacher education programs must provide systematic, practice-based, and structured learning opportunities. This ensures that competencies in differentiated instruction move beyond conceptual understanding and translate into concrete instructional practices, thereby better supporting the consideration of individual differences in teaching.

Based on the findings of this study, several recommendations have been proposed for practice and further research:

Practical Recommendations:

- Enriching courses and content related to inclusive and differentiated instruction in elementary mathematics teacher education programs.
- Incorporating differentiated instruction principles into courses such as teaching practice, special teaching methods, and micro-teaching to support prospective teachers' experiential learning in teaching.
- Providing prospective teachers with examples and instructional materials for planning, implementing, and assessing differentiated instruction.
- Offering practical experiences across different grade levels to enhance teacher candidates' self-efficacy development.
- Implementing in-service training programs for teachers based on differentiated instruction principles.

Recommendations for Research:

- Conducting comparative studies on self-efficacy perceptions toward differentiated instruction among prospective teachers in different teacher education programs.
- Complementing quantitative findings with qualitative research to explore prospective teachers' experiences, perceptions, and challenges in depth.
- Conducting research aimed at developing prospective teachers' practical skills in differentiated instruction.

Declaration of Conflicting Interests and Ethics

"The authors declare no conflict of interest."

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