

Examining Teachers' Competency Beliefs in Preparing Mathematical Activities and Their Anxiety Levels by Gender and Graduation Program

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Abstract

The purpose of this study is to investigate whether teachers' beliefs about their competence in preparing mathematical activities, as well as their mathematics teaching anxiety and mathematics anxiety levels, differ significantly by gender and type of graduation program. The study employed a correlational research design with a population of classroom teachers and elementary mathematics teachers working in Turkey during the 2024–2025 academic year, and a sample of 661 teachers from the Central Anatolia Region selected through convenience sampling. According to the research findings, teachers' mathematical activity preparation competency beliefs, mathematics anxiety, and mathematics teaching anxiety did not differ significantly according to gender. In contrast, significant differences were found among teachers' mathematical activity preparation competency beliefs, mathematics anxiety, and mathematics teaching anxiety according to the type of graduation program. It was found that classroom teachers had higher mathematical activity preparation competency beliefs, whereas elementary mathematics teachers had lower levels of both mathematics anxiety and mathematics teaching anxiety. The results indicate that teachers' mathematics-related competency beliefs and anxiety levels are more closely associated with their professional training background than with individual demographic characteristics. In this context, it is anticipated that the findings of this study will contribute to improvements in teacher education programs and in-service training practices.

Keywords: Mathematics anxiety, mathematics teaching anxiety, mathematical activity, classroom teachers, elementary mathematics teachers.

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1. INTRODUCTION

Mathematics anxiety is defined as a condition that causes individuals to experience intense stress, panic, and feelings of helplessness when confronted with a mathematical problem, negatively affecting cognitive processes (Alkan, 2010). Because this state of anxiety evokes negative emotions such as fear and worry, it leads individuals to avoid engaging with mathematics (Yenilmez & Özbey, 2006). The literature frequently emphasizes that mathematics anxiety significantly affects the learning process by causing individuals to develop negative attitudes toward mathematics (Baloğlu & Koçak, 2006; Toptaş & Gözel, 2018). It is also noted that when this anxiety is not kept under control, individuals may develop intense emotional reactions toward mathematical content (İlhan & Öner-Sünkür, 2013).

Although mathematics anxiety is often associated primarily with students, it is also prevalent among teachers. In the literature, this phenomenon among teachers is referred to as mathematics teaching anxiety and refers to the emotional tension that teachers experience during the process of teaching mathematics (Peker, 2006). It is reported that teachers who experience anxiety about teaching mathematics tend to avoid explaining mathematical concepts and theorems to their students and refrain from guiding students in mathematics-related tasks, which in turn negatively affects students' learning processes. Furthermore, it has been emphasized that the level of mathematics teaching anxiety possessed by teachers affects the instructional practices they employ in mathematics lessons (Sarı & Aksoy, 2016).

Activity-based approaches preferred in mathematics instruction are among the effective teaching approaches that support students' meaningful understanding of mathematical concepts and their active participation in the learning process (Baki & Kartal, 2004). Mathematical activities are noted to allow students to make sense of abstract mathematical concepts through concrete experiences, which in turn supports lasting learning. In activity-based instruction, students are expected to develop higher-order thinking skills such as reasoning and problem solving; therefore, activities are considered an important tool in mathematics teaching. The teacher's role is defined not as a transmitter of direct knowledge but rather as a guide who organizes the learning environment and accompanies students' discoveries.

Teachers' competency beliefs in designing and implementing activities in the mathematics instructional process are considered an important variable in determining the quality of instructional practices. Thus, it is stated that the effective implementation of activities in mathematics instruction is closely related to teachers' competencies in the processes of designing and implementing those activities. Teacher competency refers to teachers' beliefs about their ability to effectively manage the situations they encounter in the instructional process, and these beliefs are noted to directly affect instructional behaviors (Tschannen-Moran & Hoy, 2001). Mathematical activity preparation competency refers to teachers' skills in planning, implementing, and evaluating activities directed at the knowledge to be conveyed to students during mathematics lessons. It is stated that a high level of this competency allows the teacher to create richer learning environments and to plan lesson content within the framework of student-centered instructional approaches. In contrast, teachers with low activity preparation competency are noted to lean more toward ready-made materials in the instructional process and to avoid activity-based practices.

Various studies have demonstrated that teachers' anxiety related to mathematics and mathematics teaching affects the methods and techniques they use in the instructional process (Yenilmez & Özbey, 2006). It has been suggested that this anxiety condition may negatively affect teachers' competency beliefs regarding planning and implementing mathematical activities. Teachers who experience anxiety about mathematics teaching are reported to be reluctant to favor student-centered approaches and activity-based practices during lessons (Peker, 2006). Indeed, it is emphasized that teachers' competency beliefs about the instructional process constitute an important variable in determining the quality of that process, and that as anxiety levels increase, competency beliefs may weaken.

The purpose of this study is to investigate whether teachers' perceived competence in preparing mathematical activities, as well as their mathematics teaching anxiety and mathematics anxiety, differ significantly by gender and type of graduation program. In this regard, the study sought to determine whether teachers' mathematics and mathematics teaching anxiety levels, as well as their mathematical activity preparation competency beliefs, differ according to gender and type of graduation program. It is expected that the findings obtained from the study will contribute to teachers' professional competencies.

2. METHOD

The aim of this study is to determine whether teachers' beliefs about their competency in preparing mathematical activities, as well as their levels of mathematics teaching anxiety and mathematics anxiety, differ significantly with respect to gender and type of graduation program. The research questions are presented below:

- Do teachers' mathematical activity preparation competency beliefs differ according to gender and type of graduation program?
- Do teachers' mathematics teaching anxiety levels differ according to gender and type of graduation program?
- Do teachers' mathematics anxiety levels differ according to gender and type of graduation program?

2.1. Population and Sample

The population of the study consists of classroom teachers and elementary mathematics teachers working in Turkey during the 2024–2025 academic year. The sample consists of 661 classroom teachers and elementary mathematics teachers selected from the population through convenience sampling. Convenience sampling is defined as the inclusion in the sample of the participants most accessible to the researcher in terms of time, cost, and access opportunities (Baltacı, 2018). The convenience sampling method enabled the researcher to reach participants appropriate to the purpose of the study in a short period of time and contributed to the efficient conduct of the data collection process. Demographic information about the participants is presented in Table 1.

Table 1. Demographic information of participants

Variables	Groups	f	%
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Gender	Female	385	58.2
	Male	276	41.8
	Total	661	100
Graduation Program	Classroom Teaching	378	57.2
	Elementary Math Teaching	206	31.2
	Non-field Programs	77	11.6
	Total	661	100

As seen in Table 1, of the teachers participating in the study, 385 (58.2%) were female and 276 (41.8%) were male. Examining the distribution of participants by graduation program, 378 (57.2%) graduated from classroom teaching, 206 (31.2%) from elementary mathematics teaching, and 77 (11.6%) from non-field programs.

2.2. Data Collection Process

Within the scope of the study, four different measurement instruments were used simultaneously in order to examine the relationship between teachers' mathematical activity preparation competency beliefs and their mathematics and mathematics teaching anxiety. These instruments are: the Personal Information Form, the Mathematical Activity Preparation Competency Scale, the Mathematics Teaching Anxiety Scale, and the Mathematics Anxiety Scale for Teachers (MAST). Through the Personal Information Form, two closed-ended questions were included in order to obtain information about teachers' gender and type of graduation program. Research data were collected through online data collection tools that ensured the confidentiality and security of data, with participants' voluntary participation.

The Mathematical Activity Preparation Competency Scale used in the study was developed by Özenir et al. (2018). The scale, consisting of 42 items, has a three-factor structure: self-perceived competence and self-confidence, student motivation and development of instructional strategies, and general use of technology. Items on the five-point Likert-type scale are scored between 1 and 5. The validity and reliability studies of the scale were conducted by its developers, and the Cronbach Alpha internal consistency coefficient was calculated as 0.98.

Another measurement instrument used in the study, the Mathematics Anxiety Scale for Teachers (MAST), was developed by Yıldırım and Gürbüz (2017). The scale consists of 33 items and comprises five factors: anxiety arising from the nature of mathematics, self-efficacy anxiety, environmental anxiety, technology/mathematics-related anxiety, and mathematical communication anxiety. Scoring on the five-point Likert-type scale ranges from 1 to 5. The Cronbach Alpha internal consistency coefficient for the entire scale was determined to be 0.90.

The Mathematics Teaching Anxiety Scale, also used in the study, was developed by Sarı (2014) and consists of 23 items in total. The scale has a three-factor structure: anxiety experienced regarding instruction, anxiety experienced regarding content knowledge, and anxiety experienced regarding self-efficacy. Items on the five-point Likert-type scale are scored between 1 and 5. The Cronbach Alpha internal consistency coefficient of the scale was calculated as 0.89. It is noted that a Cronbach Alpha internal consistency coefficient of 0.80 or

above indicates that the scales are highly reliable (Seçer, 2015). Hence, it is possible to conclude that the measurement instruments used in the scope of this study are valid and reliable.

2.3. Data Analysis

The data collected within the scope of the study, limited to the 2024–2025 academic year, were analyzed using the SPSS statistical software package. Descriptive statistics, parametric tests, and correlational statistics were used in the analysis of the data obtained from the measurement instruments applied to teachers. A total of 661 questionnaires were collected. Prior to analysis, the dataset was screened for missing values. Eight cases were excluded due to incomplete responses on one or more variables, and the analyses were conducted using listwise deletion. Therefore, the final analytic sample consisted of 653 participants. Before proceeding with the data analysis, the Kolmogorov–Smirnov test was applied to determine whether the scores obtained from the scales used were normally distributed, and it was found that the data from all three scales satisfied the normality assumption. Accordingly, parametric tests were decided to be used in the analyses. An independent-samples t-test was applied to determine whether teachers' mathematical activity preparation competency beliefs differed according to the gender variable. Since the graduation program type variable consists of three groups, one-way analysis of variance (ANOVA) was used to examine whether teachers' mathematical activity preparation competency beliefs, mathematics anxiety levels, and mathematics teaching anxiety levels differed according to the type of graduation program. When a significant difference was detected as a result of ANOVA, the Scheffé multiple comparison test was applied to identify the source of the difference.

3. FINDINGS

The findings of this study, which aimed to determine the relationship between teachers' mathematical activity preparation competency beliefs and their mathematics anxiety and mathematics teaching anxiety, are presented below.

3.1. Findings Related to Teachers' Mathematical Activity Preparation Competency Beliefs

The relationship between the gender and graduation program variables and teachers' mathematical activity preparation competency beliefs is presented in the following section.

Table 2. Results of independent-samples t-test comparing teachers' mathematical activity preparation competency beliefs by gender

Gender	N	M	SD	df	t	p
Female	380	3.84	0.72	651	-1.55	.121*
Male	273	3.93	0.70			

*p > .05 SD: Standard Deviation df: Degrees of Freedom

Based on the data in Table 2, the independent-samples t-test results examining the effect of gender on mathematical activity preparation competency revealed no statistically significant difference between the mean scores of females ($M = 3.84$) and males ($M = 3.93$) [$t_{(651)} = -1.55$; $p > .05$]. This finding indicates that gender does not have a significant effect on mathematical activity preparation competency.

Table 3. One-way ANOVA results comparing teachers' mathematical activity preparation competency beliefs by graduation program type

Source of Variance	Sum of Squares	df	Mean Square	F	p
Between Groups	6.079	2	3.039	6.101	.002*
Within Groups	323.821	650	.498		
Total	329.900	652			

*p < .05 df: Degrees of Freedom

Table 3 presents the one-way ANOVA results conducted to determine the relationship between teachers' graduation program type and their mathematical activity preparation competency. When these results are examined, a significant difference is found among the groups [$F_{(2, 650)} = 6.101$; $p < .05$]. The Scheffé post-hoc test was applied to identify the source of the significant difference, as it compares all possible linear combinations between groups, is flexible, and is used when group sizes are unequal. The results are presented in Table 4.

Table 4. Scheffé post-hoc test results for teachers' mathematical activity preparation competency scores by graduation program type

(I) Program	(J) Program	Mean Difference (I-J)	Std. Error	p
(1) Classroom Teaching	(2) Elem. Math Teaching	.21444*	.06140	.002
	(3) Non-field Programs	.07283	.08885	.715
(2) Elem. Math Teaching	(1) Classroom Teaching	-.21444*	.06140	.002
	(3) Non-field Programs	-.14161	.09479	.328
(3) Non-field Programs	(1) Classroom Teaching	-.07283	.08885	.715
	(2) Elem. Math Teaching	.14161	.09479	.328

* p < .05

As seen in Table 4, a significant difference was found between classroom teachers and elementary mathematics teachers ($p = .002$) in favor of classroom teachers. Examining the mean differences according to the graduation program variable, it is observed that mathematical activity preparation competency is in favor of classroom teachers. Based on these results, it was concluded that teachers who graduated from classroom teaching programs believe themselves to be more competent in mathematical activity preparation than teachers who graduated from elementary mathematics teaching and non-field programs.

3.2. Findings Related to Teachers' Mathematics Teaching Anxiety

The relationship between the gender and graduation program variables and teachers' mathematics teaching anxiety levels is presented in the following section.

Table 5. Results of independent-samples t-test comparing teachers' mathematics teaching anxiety levels by gender

Gender	N	M	SD	df	t	p
Female	380	1.87	0.60	651	0.697	.490*
Male	273	1.84	0.64			

*p > .05 SD: Standard Deviation df: Degrees of Freedom

Based on the data in Table 5, the independent-samples t-test results examining the effect of gender on mathematics teaching anxiety revealed no statistically significant difference between the anxiety levels of females ($M = 1.87$) and males ($M = 1.84$) [$t_{(651)} = 0.697$; $p > .05$]. This finding indicates that gender does not have a significant effect on mathematics teaching anxiety levels.

Table 6. *One-way ANOVA results comparing teachers' mathematics teaching anxiety levels by graduation program type*

Source of Variance	Sum of Squares	df	Mean Square	F	p
Between Groups	6.624	2	3.312	8.654	.001*
Within Groups	248.763	650	.383		
Total	255.387	652			

* $p < .05$ df: Degrees of Freedom

In Table 6, which examines the relationship between teachers' graduation program type and their mathematics teaching anxiety levels, it was found that mathematics teaching anxiety levels differed significantly according to the type of graduation program [$F_{(2, 650)} = 8.654$; $p < .05$]. The Scheffé post-hoc test was applied to identify the source of the significant difference, and the results are presented in Table 7.

Table 7. *Scheffé post-hoc test results for teachers' mathematics teaching anxiety scores by graduation program type*

(I) Program	(J) Program	Mean Difference (I-J)	Std. Error	p
(1) Classroom Teaching	(2) Elem. Math Teaching	-.19664*	.05381	.001
	(3) Non-field Programs	.08027	.07787	.588
(2) Elem. Math Teaching	(1) Classroom Teaching	.19664*	.05381	.001
	(3) Non-field Programs	.27691*	.08308	.004
(3) Non-field Programs	(1) Classroom Teaching	-.08027	.07787	.588
	(2) Elem. Math Teaching	-.27691*	.08308	.004

* $p < .05$

As seen in Table 7, there was a significant difference between elementary mathematics teachers and classroom teachers ($p < .05$), and between elementary mathematics teachers and teachers who graduated from non-field programs ($p < .05$). Examining the mean differences, it was determined that elementary mathematics teachers had lower mathematics teaching anxiety than classroom teachers and teachers from non-field programs.

3.3. Findings Related to Teachers' Mathematics Anxiety

The relationship between the gender and graduation program variables and teachers' mathematics anxiety levels is presented in the following section.

Table 8. *Results of independent-samples t-test comparing teachers' mathematics anxiety levels by gender*

Gender	N	M	SD	df	t	p
Female	380	2.03	0.51	651	-1.528	.127*
Male	273	2.09	0.54			

*p > .05 SD: Standard Deviation df: Degrees of Freedom

Based on the data in Table 8, the independent-samples t-test revealed no statistically significant difference between the mathematics anxiety levels of females ($M = 2.03$) and males ($M = 2.09$) [$t_{(651)} = -1.528$; $p > .05$]. In other words, gender has no significant effect on mathematics anxiety.

Table 9. One-way ANOVA results comparing teachers' mathematics anxiety levels by graduation program type

Source of Variance	Sum of Squares	df	Mean Square	F	p
Between Groups	14.050	2	7.025	28.246	.000*
Within Groups	161.663	650	.249		
Total	175.713	652			

*p < .05 df: Degrees of Freedom

Table 9 presents the one-way ANOVA results conducted to determine the relationship between teachers' graduation program type and their mathematics anxiety levels. These results indicate a significant difference among the groups [$F_{(2, 650)} = 28.246$; $p < .05$]. The Scheffé post-hoc test was applied to identify the source of this significant difference, and the results are presented in Table 10.

Table 10. Scheffé post-hoc test results for teachers' mathematics anxiety scores by graduation program type

(I) Program	(J) Program	Mean Difference (I-J)	Std. Error	p
(1) Classroom Teaching	(2) Elem. Math Teaching	.32000*	.04338	.000
	(3) Non-field Programs	.02603	.06278	.918
(2) Elem. Math Teaching	(1) Classroom Teaching	-.32000*	.04338	.000
	(3) Non-field Programs	-.29397*	.06698	.000
(3) Non-field Programs	(1) Classroom Teaching	-.02603	.06278	.918
	(2) Elem. Math Teaching	.29397*	.06698	.000

* p < .05

As seen in Table 10, a significant difference was found between classroom teachers and elementary mathematics teachers ($p < .05$), and between elementary mathematics teachers and teachers from non-field programs ($p < .05$). Examining the mean differences, it was determined that elementary mathematics teachers had a lower mathematics anxiety average compared to the other teachers. When the findings are evaluated in general terms, it is observed that teachers' mathematical activity preparation competency beliefs and mathematics and mathematics teaching anxiety did not differ significantly according to the gender variable, whereas the type of graduation program emerged as a determining variable for all three variables.

4. DISCUSSION

The present study examined teachers' mathematical activity preparation competency beliefs, mathematics anxiety, and mathematics teaching anxiety in terms of gender and type of graduation program. The findings are discussed below in relation to the existing literature.

The results of this study revealed no statistically significant gender-based differences in mathematical activity preparation competency beliefs, mathematics teaching anxiety, or mathematics anxiety. This finding is consistent with the broader literature. Kaçar and Sarıçam (2015) investigated gender-based differences in mathematics anxiety among prospective classroom teachers and found that gender was not a significant factor in mathematics anxiety. Elçelik and Taşdan (2023) found no significant gender-based differences in mathematical activity preparation competency beliefs among classroom teachers. The convergence of these findings across different studies suggests that gender may not function as a primary determinant of teachers' mathematics-related affective variables. A plausible interpretation is that pre-service teacher education programs expose both male and female candidates to equivalent mathematical content and pedagogical experiences, thereby attenuating gender-based differences in these constructs.

With regard to the type of graduation program, classroom teachers demonstrated significantly higher mathematical activity preparation competency beliefs compared to elementary mathematics teachers. This finding may seem counterintuitive at first glance, given that elementary mathematics teachers possess deeper content knowledge in mathematics. A possible explanation is that classroom teacher education programs place a strong emphasis on the design and application of activity-based instructional methods across multiple subject areas, which may cultivate a heightened sense of pedagogical self-efficacy specifically related to activity preparation. This interpretation aligns with the view that competency beliefs are shaped more by pedagogical training experiences than by content knowledge alone. It is important to note, however, that the limited availability of studies directly comparing these two groups on this variable makes it difficult to draw definitive conclusions, and further research is warranted (Elçelik & Taşdan, 2023).

Elementary mathematics teachers exhibited significantly lower mathematics anxiety levels compared to both classroom teachers and teachers from non-field programs. This outcome is theoretically coherent because sustained engagement with advanced mathematical content throughout one's training typically reduces mathematics anxiety by fostering strong content familiarity and mathematical self-efficacy. This finding is consistent with Karaman and Çil (2021), who reported that classroom teachers tended to feel inadequate in terms of mathematical content knowledge, whereas elementary mathematics teachers experienced difficulties more in relation to the process of mathematics instruction. The current finding extends this line of research by demonstrating that this differential exposure to mathematical content also manifests in measurably different anxiety levels among in-service teachers.

Similarly, elementary mathematics teachers displayed significantly lower mathematics teaching anxiety compared to both classroom teachers and non-field graduates. Teachers who have received specialized mathematics teacher education are likely to have developed greater instructional confidence and pedagogical content knowledge, thereby reducing anxiety associated with teaching mathematical concepts and guiding student learning. This result resonates with Peker's (2006) argument that mathematics teaching anxiety is closely tied to perceived instructional self-efficacy, and with Sarı and Aksoy's (2016) finding that teaching anxiety is related to teachers' instructional style preferences. The connection between program

type and teaching anxiety further supports the view that high-quality, content-specific pre-service training is a protective factor against mathematics teaching anxiety.

Taken together, the findings indicate that teachers' type of professional education program is a stronger differentiating factor for mathematics-related affective variables than gender. This pattern aligns with Bandura's (1997) self-efficacy theory, which identifies mastery experiences—accumulated through program-specific training—as the primary source of efficacy beliefs. It also supports Tschannen-Moran and Hoy's (2001) assertion that the quality and nature of pre-service training directly shape teachers' confidence in managing instructional situations. The implication is that the content, pedagogical emphasis, and affective climate of teacher education programs have lasting consequences for teachers' anxiety and competency beliefs well into their careers.

Several limitations of this study should be acknowledged. First, the sample was restricted to the Central Anatolia Region and selected through convenience sampling, which limits the generalizability of the findings to all classroom teachers and elementary mathematics teachers in Turkey. Second, the reliance on self-report instruments introduces the possibility of social desirability bias, as teachers may overestimate their competency or underreport their anxiety. Future studies could employ mixed-method designs to offer richer, more nuanced insights into how program type shapes teachers' affective profiles. Replication of the study across diverse geographic regions and school types would improve the external validity of the findings. Longitudinal research would also help clarify whether the observed group differences persist, diminish, or intensify over the course of teachers' professional careers.

5. RECOMMENDATIONS

In light of the findings obtained in this study, the following recommendations have been developed for teacher education processes and future research:

- In-service training programs incorporating activity-based instructional practices can be organized to support teachers' competency beliefs related to mathematical activity preparation.
- The course content of classroom teaching and elementary mathematics teaching undergraduate programs can be reviewed in a manner that will develop competencies related to the design and implementation of mathematical activities.
- This study was conducted using quantitative methods. In future research, more in-depth data can be obtained by using qualitative or mixed methods.
- By replicating the study with teachers working in different geographic regions and different types of schools, the generalizability of the findings can be increased.

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