Mathematics Anxiety, Perceived Mathematics Self-efficacy and Learned Helplessness in Mathematics in Faculty of Education Students

Nejla GUREFE¹, Orkide BAKALIM²

¹Uşak University, Faculty of Education, Uşak, Turkey
²Izmir Democracy University, Faculty of Education, Izmir, Turkey

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ABSTRACT

There are various factors influencing learning and academic achievement of individuals. These may be external factors which do not arise from the individual, or affective factors which are closely related with the individual. In this study, affective factors such as anxiety, self-efficacy, and learned helplessness which influence learning performance of prospective teachers in mathematics were investigated with respect to their various characteristics, the mediating effect of self-efficacy in the relationship between mathematics anxiety and learned helplessness was examined. A quantitative pattern was employed in the study and it was found that there were significant differences between prospective teachers from different departments in terms of mathematics anxiety, perceived self-efficacy, and learned helplessness, there was a positive and significant correlation between anxiety and learned helplessness, whereas perceived mathematics self-efficacy had a full mediating effect in the relationship between mathematics anxiety and learned helplessness.

Keywords:
Mathematics anxiety, perceived mathematics self-efficacy, learned helplessness in mathematics, faculty of education students

Introduction

In mathematics, affective factors are considered to be just as important as cognitive variables in learning and teaching processes (Nicolaou & Philippou, 2007). Anxiety, self-efficacy, and learned helplessness are affective traits possessed by individuals (Braham, 1998; Philipp, 2007). It is noted in the literature that such affective variables influence mathematical performance (Qian & Alvermann 1995). Studies show that anxiety and learned helplessness negatively impact student achievement (Alkan, 2011; Ma, 1999) and are common problems encountered by educators, whereas self-efficacy is reported to positively impact academic achievement of students (Reçber, 2011).

Mathematics anxiety usually refers to tension or fear of mathematics which prevents the student from understanding mathematics subjects (Fulkerson, Galassi, & Galassi, 1984), mathematics anxiety and its characteristics are addressed in different ways by researchers in the literature. Ashcraft and Faust (1994) defines mathematics anxiety as feelings of tension, apprehension, or even dread that interfere with the
ordinary manipulation of number and the solving of mathematical problems. Tobias (1993) defines mathematics anxiety as panic, helplessness, paralysis, and mental disorganization that arises at the time of solving mathematical problems; whereas Bessant (1995) defines mathematics anxiety as a negative attitude towards learning mathematics, fear of failure, and lack of self-confidence. Rather than a learning difficulty, Reynolds (2003) addresses mathematics anxiety as a feeling which puts individuals in a position that is difficult to cope with. However, this feeling is not as simple as a dislike for mathematics (Vinson, 2001), but strong as to cause sadness, tension, fear, mental disorder, helplessness, disappointment, and worry (Ma & Xu, 2004). Mathematics anxiety does not only cause an academic failure in the individual’s school life, but it also causes an emotional tension and worry in cases where the individual needs to solve a mathematical problem or manipulate numbers in everyday life (Tobias, 1993), prevents the individual from thinking clearly, and causes difficulties when establishing the organization and association between pieces of information (Rotella & Learner, 1993). It is reported that this state of anxiety sometimes leads to obliviousness and causes the individual to lose self-confidence (Tobias, 1993). Indeed, it is reported that when the anxiety reaches its highest level, in other words when panic sets in, the learning efficiency drops to its lowest level (Cüceloğlu, 2004). Therefore, it is possible to say that anxiety has a strong impact on learning. However, the literature suggests that mathematics anxiety ought to be addressed as both positive and negative (Bai, Wang, Pan, & Frey, 2009). While ideas such as “I think I will use the mathematics in my future” reflect positive anxiety, ideas such as “I am worried about my ability to solve mathematical problems” reflect negative anxiety (Akçakın, Cebesoy, & İnel, 2015). Here, it would not be correct to claim that anxiety always has a negative impact on the individual. Indeed, negative anxiety leads to negative feelings and thoughts, whereas positive anxiety leads to positive feelings and thoughts. In this sense, it is important to investigate mathematics anxiety, which is effective on prospective teachers’ learning of mathematics.

Bandura (1997) defines self-efficacy as one’s judgments of one’s capabilities to organize and execute courses of action required to attain designated types of performances. Mathematics self-efficacy, on the other hand, is one’s confidence in one’s ability to solve a mathematical problem or complete a mathematical task (Hackett & Betz, 1989). Mathematics self-efficacy positively impacts academic achievement by allowing one to use cognitive strategies, enhancing the belief in successful completion of tasks, and encouraging one to come up with alternative solutions for the problem in hand (Stevens, Olivarez, Lan, & Runnels, 2004). Studies shows that students with high-perceived self-efficacy make more effort to accomplish a task and are more persistent in the face of difficulties (Aşkar & Umay, 2001). Hackett & Betz (1989) report that students with higher mathematics self-efficacy have lower mathematics anxiety and place more value on mathematics.

Learned helplessness is when one observes a discrepancy between one’s behavior and the outcome of such behavior, and the lack of will to repeat the same behavior in future believing that the same outcome will occur, even when it is evident that it will not lead to the same outcome (Maier, Seligman, & Solomon, 1976). Individuals who exhibit learned helplessness believe that their negative experiences cannot be changed and resort to generalizations (Biber & Başer, 2014 cited in Abramson). Those who experience this feeling do not strive and give up quickly even when situations in which they can be successful are presented (Aydın, 2006). Moreover, individuals who exhibit learned helplessness do not only expect failure, they also fail to see their competences required to perform a task successfully (Biber & Başer, 2014). Unfortunately, prospective teachers who experience learned helplessness cannot learn mathematics on the desired level. Biber and Başer (2014), too, report that learned helplessness negatively impacts academic performance of students.

Studies in the literature state that affective factors are just as important as cognitive factors in learning, and influence mathematics learning (Philipp, 2007; Reyes, 1984). As a matter of fact, Borich (2014) suggests that cognitive and affective factors intertwined structures. Studies on affective factors investigate the effect of mathematics anxiety on mathematical achievement (Hembree, 1990; Osborne, 2001; Ramirez, Chang, Maloney, Levine, & Beilock, 2016) mathematics anxiety depending on various variables (Aydın & Keskin, 2017; Baloğlu & Koçak, 2006; Dede & Dursun, 2008; Tapia, 2004), the relationship between mathematics self-efficacy and mathematical achievement (Chen, 2002; Moore, 2005; Pajares, & Miller, 1994), mathematics self-efficacy depending on various variables (Çakırköl & İşkilal, 2009), mathematics teachers’ self-efficacy towards mathematics teaching (Dede, 2008), the relationship between learned helplessness in relation to mathematics and mathematical achievement (Qian & Alvermann 1995), the relationship between mathematics anxiety and perceived mathematics self-efficacy (Adal & Yavuz, 2017; Hackett & Betz, 1989), and the effect of self-efficacy...
on learned helplessness (Ekinci & Gökler, 2017). However, to the best of our knowledge, there is no study in the literature addressing learned helplessness in mathematics, perceived mathematics self-efficacy, and mathematics anxiety together and examining learned helplessness of prospective teachers in mathematics. Prospective teachers often have to solve mathematical problems in exams which determine whether or not they are assigned to institutions as teachers, and mathematics anxiety, perceived mathematics self-efficacy, and learned helplessness in mathematics impact their success in mathematics. Therefore, this study investigates mathematics anxiety, perceived mathematics self-efficacy, and learned helplessness in mathematics of prospective teachers who educated on Science Teaching (ST), Elementary School Mathematics Teaching (ESMT), Psychological Counseling and Guidance (PCG), Turkish Language Teaching (TLT), Preschool Teaching (PT), Social Studies Teaching (SST) and Classroom Teaching (CT) Departments of Education Faculty with respect to various variables. The study also suggests a theoretical model related to relationships between mathematics anxiety (positive and negative anxiety), perceived mathematics self-efficacy, and learned helplessness in mathematics. Because, some studies show that anxiety is a powerful variable which impacts one’s self-efficacy (Pajares, 2003; Doruk, Öztürk & Kaplan, 2016). Further, low self-efficacy may lead to learned helplessness (Ekinci & Gökler, 2017). In this suggested model, mathematics anxiety is addressed in two dimensions, positive and negative, whereas other variables are addressed as single-dimensional. The theoretical model suggested based on this information can be seen in Figure 1.

![Diagram](image.png)

**Figure 1.** The relationship between mathematics anxiety (positive anxiety, negative anxiety), perceived mathematics self-efficacy, and learned helplessness

Revealing affective traits of the individual allows for understanding the state of the individual and predicts future behavior (Tekin, 1996). The significance of the study lies in this point. Because, high mathematics anxiety, learned helplessness and low mathematics self-efficacy can negatively impact the performance of prospective teachers during the vocational entrance examination. In line with the purposes of the study, the research hypotheses are as follows:

(i) There is a significant difference between prospective teachers from different departments in terms of mathematics anxiety (MA), perceived mathematics self-efficacy (PMS), and learned helplessness in mathematics (LHM). (ii) There is a significant difference between prospective teachers from different high school departments in terms of MA, PMS, and LHM. (iii) There is a positive and significant correlation between negative anxiety (NA) and LHM, and a negative and significant correlation between positive anxiety (PA) and LHM. (iv) There is a negative and significant correlation between NA and PMS, and a positive and significant correlation between PA and PMS. (v) There is a negative and significant correlation between PMS and LHM. (vi) PMS has a mediating effect in the relationship between MA (PA and NA) and LHM.

**Method**

**Participants**

The participants of the study were prospective teachers attending the Faculty of Education in Western Turkey. The participants were selected among senior prospective teachers who were to enter the public personnel selection exam using the purposive sampling method. 277 prospective teachers participated in the study on a voluntary basis. Departments of the prospective teachers were ST (22 participants), ESMT (41
participants), PCG (39 participants), TLT (34 participants), PT (35 participants), SST (39 participants), and CT (67 participants). 201 participants were female and 76 participants were male. Ages of the prospective teachers varied from 20 to 30. However, 21 was the most common age (117 participants), followed by 22 (95 participants). 75 prospective teachers graduated from science department of high school with basic science and mathematics courses. 165 prospective teachers graduated from the equally-weighted department of high school with basic Turkish Language and mathematics courses, and 37 graduated from the social studies department of high school with basic Turkish Language, History and Geography courses, but at least mathematics course.

**Data Collection Tools and Process**

Three different scales tested for validity and reliability were used in the study to collect data: “The Bidimensional Mathematics Anxiety Scale”, “The Scale of Perceived Mathematics Self-efficacy”, and “The Scale of Learned Helplessness in Mathematics”.

The Two-dimensional Mathematics Anxiety Scale: The scale was developed by Bai, Wang, Pan, and Frey (2009) and adapted Akçakın, Cebesoy, & İnel (2015). The internal consistency of the scale was found to be 0.91. The scale is scored as “Strong Agree (1 point)”, “Agree (2 points)”, “Neutral (3 points)”, “Disagree (4 points)”, and “Strongly Disagree (5 points)”. The scale consists of two factors: “positive effect” and “negative effect”. In present study, the reliability coefficient of the scale was found to be 0.93.

The Scale of Perceived Mathematics Self-efficacy: The scale was developed by Umay (2001). The reliability coefficient of the scale was found to be 0.87. The scale is scored as “Never (1 point)”, “Rarely (2 points)”, “Sometimes (3 points)”, “Often (4 points)”, and “Always (5 points)”. The scale consists of three factors including “self-perception in mathematics”, “awareness regarding mathematical behavior”, and “ability to apply mathematics as an everyday skill”. In present study, the reliability coefficient of the scale was found to be 0.90.

The Scale of Learned Helplessness in Mathematics: The scale was developed by Biber & Başer (2014). The reliability coefficient of the scale was found to be 0.82. Each item of the scale tells an event, and the respondent is expected to choose one of the two options, a and b, in the face of the event. The option which indicates helplessness is scored as “1”, and the other option is scored as “0”. The scale consists of three factors including “internal-external”, “specific-general”, and “inalterable-alterable”. In present study, the reliability coefficient of the scale was found to be 0.91.

The scales specified above were given to the prospective teachers. The prospective teachers were given about 30 minutes to complete the scales.

**Data Analysis**

SPSS 20.0 and Lisrel softwares were used for quantitative analysis in this study. SPSS was used for One-way ANOVA and correlation analysis, whereas Lisrel was used for structural equation modeling.

**Findings**

**Examination of Prospective Teachers’ PMS, MA, and LHM Depending on the University Department Variable**

The one-way ANOVA was used to determine whether or not there was a difference between prospective teachers in terms of PMS, MA, and LHM depending on their departments in university. The average perceived mathematics self-efficacy score was ESMT ( \( \bar{X} = 41.4091 \) ), CT ( \( \bar{X} = 42.4627 \) ), PCG ( \( \bar{X} = 42.2308 \) ), PT ( \( \bar{X} = 41.6000 \) ), ST ( \( \bar{X} = 41.4091 \) ), SST ( \( \bar{X} = 32.9744 \) ), and TLT ( \( \bar{X} = 30.9118 \) ) in descending order, whereas the average score for all prospective teachers was \( \bar{X} = 40.1191 \). It was seen that the prospective
teachers in the ESMT department had the highest perceived self-efficacy, whereas the prospective teachers in the TLT department had the lowest perceived self-efficacy. The average mathematics anxiety score was TLT (\(\bar{X} = 48.9706\)), SST (\(\bar{X} = 46.4615\)), ST (\(\bar{X} = 35.9091\)), PT (\(\bar{X} = 35.0857\)), CT (\(\bar{X} = 33.7761\)), PCG (\(\bar{X} = 33.7179\)), and ESMT (\(\bar{X} = 28.0244\)) in descending order, whereas the average score for all prospective teachers was \(\bar{X} = 36.9025\). Based on these findings, it was seen that the prospective teachers in the TLT department had the highest level of anxiety, whereas the prospective teachers in the ESMT department had the lowest level of anxiety. The average learned helplessness in mathematics score was TLT (\(\bar{X} = 20.9706\)), SST (\(\bar{X} = 20.1026\)), CT (\(\bar{X} = 12.4776\)), ST (\(\bar{X} = 11.9545\)), PCG (\(\bar{X} = 11.0256\)), PT (\(\bar{X} = 10.6571\)), and ESMT (\(\bar{X} = 6.8537\)) in descending order, whereas the average score for all prospective teachers was \(\bar{X} = 13.2852\). Based on these findings, it was seen that the prospective teachers in the TLT department had the highest level of learned helplessness, whereas the prospective teachers in the ESMT department had the lowest level of learned helplessness. The one-way ANOVA was used to determine whether the difference between these averages was significant. The ANOVA data can be seen in Table 1.

### Table 1. One Way ANOVA Results Regarding PMS, MA, LHM in terms of Section

<table>
<thead>
<tr>
<th>Scales</th>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPS</td>
<td>Between Groups</td>
<td>7334,500</td>
<td>6</td>
<td>1222,417</td>
<td>19,690</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>16762,569</td>
<td>270</td>
<td>62,084</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>24097,069</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>Between Groups</td>
<td>12934,629</td>
<td>6</td>
<td>2155,772</td>
<td>17,108</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>34021,739</td>
<td>270</td>
<td>126,006</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>46956,368</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHM</td>
<td>Between Groups</td>
<td>6040,256</td>
<td>6</td>
<td>1006,709</td>
<td>23,509</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>11562,213</td>
<td>270</td>
<td>42,823</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>17602,469</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in Table 1, there was a significant difference between prospective teachers from different departments in terms of average PMS, MA, and LHM scores (\(p<.05\)). The post-hoc multiple comparison analysis was used to find the source of this difference. The Levene test was performed to decide which post-hoc multiple comparison technique to use and it was found that the variations were not homogeneous. Values of F(6, 270)= 5.145, F(6, 270)= 2.574, F(6, 270)= 10.389, \(p<.05\) were found for the scales respectively. In this case, the Dunnet C test was used to determine the source of the difference between the groups. According to the results of the Dunnet C test, there were differences between PMS scores of participants from different departments and these differences were found to be significant (\(p<.05\)). Considering PMS scores, there were significant differences between the participants from the TLT department and all other participants except for those from the SST department. It was also found that there were significant differences between the participants from the SST department and all other participants (\(p<.05\)). Based on this finding, it can be said that prospective teachers from the TLT and SST departments had lower perceived self-efficacy compared to prospective teachers from other departments. Further, significant differences were found between prospective teachers from the ESMT and those from the PT and CT departments (\(p<.05\)). In other words, it was observed that those from the ESMT department had higher perceived self-efficacy compared to those from the PT and CT departments. Considering MA scores, there were significant differences between the participants from the TLT department and all other participants except for those from the SST and CT departments (\(p<.05\)). It can be said that those from the TLT department had higher anxiety levels compared to those from the SST and CT departments. Similarly, there were significant differences between the participants from the SST department
and all other participants except for those from the TLT department \((p<.05)\). In other words, those from the SST department had higher mathematics anxiety compared to many other departments. There was no significant difference between ESMT and ST departments in terms of LHM and MA, while there was a significant difference in terms of LHM \((p<.05)\). Also, there were significant differences between the participants from the ESMT department and all other participants \((p<.05)\). Also, there were significant differences between the participants from the TLT department and all other participants except for those from the SST, whereas there were significant differences between the participants from the SST department and all other participants except for those from the TLT \((p<.05)\). In this case, Hypothesis 1 was accepted for some departments and rejected for some others. Therefore, Hypothesis 1 was partially accepted.

**Examination of Prospective Teachers’ PMS, MA, and LHM Depending on the High School Department Variable**

The one-way ANOVA was used to determine whether or not there was a significant difference between participants in terms of PMS, MA, and LHM depending on their departments in high school. Those from the science department had a higher PMS average than those from the equally-weighted department, while those from the equally-weighted department had a higher PMS average than those from the social sciences department. Considering average MA and LHM scores, those from the science department had the highest score, whereas those from the social sciences department had the lowest score.

**Table 2. One Way ANOVA Results Regarding PMS, MA and LHM in terms of High School Graduation Department**

<table>
<thead>
<tr>
<th>Scales</th>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMS</td>
<td>Between Groups</td>
<td>7082,325</td>
<td>2</td>
<td>3541,163</td>
<td>57,026</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>17014,743</td>
<td>274</td>
<td>62,098</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>24097,069</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>Between Groups</td>
<td>12270,709</td>
<td>2</td>
<td>6135,354</td>
<td>48,466</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>34685,660</td>
<td>274</td>
<td>126,590</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>46956,368</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHM</td>
<td>Between Groups</td>
<td>5926,971</td>
<td>2</td>
<td>2963,486</td>
<td>69,547</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Within Groups</td>
<td>11675,498</td>
<td>274</td>
<td>42,611</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>17602,469</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown in Table 2, there was a significant difference between prospective teachers from different high school departments in terms of average PMS, MA, and LHM scores \((p<.05)\). The post-hoc multiple comparison analysis was used to find the source of this difference. The Levene test was performed to decide which post-hoc multiple comparison technique to use and it was found that the variations were homogeneous. Values of \(F(2, 274)= 2.401, F(2, 274)= .508, F(2, 274)= 2.127, p>.05\) were found for the scales respectively. In this case, the Tukey test was used to determine the source of the difference between the groups. According to the results of the Tukey test, there were significant differences between all combinations of high school departments in terms of MA, PMS, and LHM scores \((p<.05)\). Considering PMS scores, there was a significant difference between those from the science department and those from the social sciences department in favor of the science department \((p<.05)\). There was a significant difference between those from the equally-weighted department and those from the social sciences department in favor of the equally-weighted department \((p<.05)\). There was also a significant difference between those from the science department and those from the equally-weighted department in favor of the science department \((p<.05)\). In other words, those from the science department had higher perceived mathematics self-efficacy than those from the equally-weighted department, whereas those from the equally-weighted department had higher perceived mathematics self-efficacy than...
those from the social sciences department. Considering MA and LHM scores, there was a significant difference
between those from the social sciences department and those from the science department in favor of the social
sciences department \((p<.05)\). There was a significant difference between those from the social sciences
department and those from the equally-weighted department in favor of the social sciences department
\((p<.05)\). There was also a significant difference between those from the science department and those from the
equally-weighted department in favor of the equally-weighted department \((p<.05)\). Based on these findings, it
is possible to say that those from the social sciences department had higher mathematics anxiety and learned
helplessness than those from the equally-weighted department, who had higher mathematics anxiety and
learned helplessness than those from the science department \((p<.05)\). In this case, Hypothesis 2 was accepted
for some departments and rejected for some others. Therefore, Hypothesis 2 was partially accepted.

**Findings Showing the Correlations between PMS, MA, and LHM**

The Pearson Correlation Coefficient was calculated to reveal the relationships between PMS, MA (PA
and NA), and LHM scores of the faculty of education students. The results can be seen in Table 3.

**Table 3.** Correlation between Scores of PMS, MA and LHM

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. NA</td>
<td>-.78**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. PA</td>
<td>.79**</td>
<td>-.69**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. LHM</td>
<td>-.80**</td>
<td>.72**</td>
<td>-.73**</td>
<td></td>
</tr>
</tbody>
</table>

There was a negative, strong, and significant correlation between total PMS and NA scores \((r = -.78, p< .05)\); a positive, strong, and significant correlation between total PMS and PA scores \((r = .79, p< .05)\); a negative, strong, and significant correlation between PA and NA scores \((r = -.69, p< .05)\); a negative, strong, and significant correlation between PMS and LHM scores \((r = -.80, p< .05)\); a positive and significant correlation between LHM and NA scores \((r = .72, p< .05)\); and a negative, strong, and significant correlation between LHM and PA scores \((r = -.73, p< .05)\). Hypotheses 3, 4, and 5 were accepted based on these findings.

**Findings Related to Testing the Measurement Model**

The measurement model must be tested to assess whether or not the data supports the model shown in
Figure 1 (Huchting, Andrew, & Loseph, 2008). Before testing the proposed theoretical model, it was analyzed
whether or not each measurement model related to the variables in the model was validated. Table 4 shows
the resulting fitness statistics and normal values (Tabachnick & Fidell, 2015).

**Table 4.** Results Related to Measurement Models and Measuring Model

<table>
<thead>
<tr>
<th>Scale/Model</th>
<th>(\chi^2)</th>
<th>df</th>
<th>(\chi^2/df)</th>
<th>CFI</th>
<th>IFI</th>
<th>NFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMS</td>
<td>169.03</td>
<td>51</td>
<td>3.31</td>
<td>.97</td>
<td>.97</td>
<td>.96</td>
<td>.07</td>
</tr>
<tr>
<td>MA</td>
<td>196.85</td>
<td>73</td>
<td>2.69</td>
<td>.98</td>
<td>.98</td>
<td>.98</td>
<td>.07</td>
</tr>
<tr>
<td>LHM</td>
<td>1435.25</td>
<td>526</td>
<td>2.73</td>
<td>.94</td>
<td>.94</td>
<td>.90</td>
<td>.07</td>
</tr>
<tr>
<td>Normal Value</td>
<td>&lt;2</td>
<td>&gt;.95</td>
<td>&gt;.95</td>
<td>&gt;.95</td>
<td>&gt;.95</td>
<td>&lt;.05</td>
<td></td>
</tr>
<tr>
<td>Acceptable Value</td>
<td>&lt;5</td>
<td>&gt;.90</td>
<td>&gt;.90</td>
<td>&gt;.90</td>
<td>&gt;.90</td>
<td>&lt;.08</td>
<td></td>
</tr>
</tbody>
</table>

As shown in Table 4, the resulting fitness indices validated the measurement model. Accordingly,
fitting values of the measurement model for perceived mathematics self-efficacy were \(\chi^2=169.03, df=51, \chi^2/df=3.31, CFI=.97, IFI=.97, NFI=.96, RMSEA=.07\); fitting values of the measurement model for the bidimensional mathematics anxiety were \(\chi^2=196.85, df=73, \chi^2/df=2.69, CFI=.98, IFI=.98, NFI=.98, RMSEA=.07\); and fitting values of the measurement model for learned helplessness in mathematics were \(\chi^2=1435.25, df=526, \chi^2/df=2.73, CFI=.94, IFI=.94, NFI=.90, RMSEA=.07\). Considering these values, the general model fitness and RMSEA were acceptable for all three of the scales, and other values showed good fitness as well (Tabachnick & Fidell, 2015). With this data, each measurement model included in the proposed model was validated. In conclusion,
it was found that the structural model of the measurement model could be used to explain PMS by keeping MA and LHM in their respective places within the model.

**Examining the structural equation model**

Path diagrams for the variables and path coefficients for the relationships were obtained, goodness of fit indices for the model were determined, and the model was interpreted with the findings in this section of the study.

**The first model**

The hypothesis model proposed within the scope of the study was examined using the path analysis. Firstly, the model where NA and PA are independent variables and learned helplessness in mathematics is dependent variable was tested. Figure 2 shows the resulting correlation coefficients and t values.

![Path diagram](image)

\[
\chi^2/df = 2.21, \text{IFI} = .97, \text{CFI} = .97, \text{NNFI} = .97, \text{RMSEA} = .06 (N = 277), \quad ** p< 0.05
\]

*Figure 2. Standardized correlation coefficients and t values for the first model*

As shown in Figure 2, the ratio of chi-square to the degree of freedom was 2.21 in the first model with no mediating variables. A value lower than 3 indicates excellent fitness, while a value lower than 5 indicates moderate fitness (Çokluk, Şekercioğlu, & Büyüköztürk, 2010). The fact that a value lower than 3 was found for the first model shows that it had excellent data fitness. On the other hand, the fact that IFI CFI, and NNFI values were above .95 supports the excellent model-data fitness. The fact that the RMSEA value was found to be .06 indicates acceptable fitness (Kline, 2013).

**The structural model**

After examining the first model, the hypothetical structural model where PMS is the mediating variable was tested. Figure 3 shows the resulting correlation coefficients and t values.
As shown in Figure 3, paths between NA and PA and paths between PMS and LHM were found to be significant in the structural model. Also, the ratio of the chi-square value of the model to the degree of freedom was 2.10, and IFI, CFI, NFI, NNFI, and RMSEA values were .97, .97, .94, .97, and .06 respectively. These values indicate that the proposed theoretical model was supported by the data. Also, while the correlation coefficient between NA and LHM was .40 in the first model without PMS as the mediating variable, the correlation coefficient dropped to .05 after adding PMS as the mediating variable. The correlation coefficient between PA and LHM, which was -0.52 in the first model, dropped to -0.08 after adding the mediating variable. In order to determine the mediating variable, the best fitness indices must be obtained by “the path from the independent variable to the mediating variable, and from mediating variable to the dependent variable”, and the path coefficients between “the independent variable and the dependent variable” must decrease (partial mediation) or disappear (full mediation) after adding the mediating variable to the model (Şimşek, 2007). In the second model (Figure 3), the correlation between positive and negative anxiety and learned helplessness disappeared after adding the perceived mathematics self-efficacy (values of .05 and .08), which indicates that the perceived self-efficacy was a full mediator in the relationship between anxiety and learned helplessness.

**Conclusion and Discussion**

PMS, MA (NA and PA), and LHM levels of senior students attending the faculty of education were determined using scales in this study. Significant differences were found between prospective teachers in terms of PMS, MA, and LHM depending on their departments in university and high school, significant paired correlations were found between PMS, MA, and LHM, and it was found that PMS was a mediator in the relationship between MA and LHM.

Considering MA scores, it was found that those from the social sciences department had higher mathematics anxiety than those from the equally-weighted department, who had higher mathematics anxiety than those from the science department. Resnick, Viehe, & Segal (1982) found that students with mathematics anxiety considered this anxiety as a problem for themselves when choosing a profession, and gravitated towards professions which do not include mathematics, also, in this study, it was obtained similar finding. Similarly, Sirmacı (2007) found that students who mostly enjoy social sciences subjects had higher mathematics anxiety compared to those who mostly enjoy mathematics-related subjects, and students with mathematics anxiety avoided the mathematics course, students from the Social Studies Teaching department had higher MA compared to those from the Elementary School Mathematics Teaching department. This finding of Sirmacı (2007) is consistent with our finding that students from the social sciences department had
higher mathematics anxiety compared to those from the science department. In fact, whether a student likes mathematics or social sciences may be related to domains of intelligence. Indeed, Sloan, Daane, & Giesen (2002) examined the relationship between learning styles and mathematics anxiety, and showed that mathematics anxiety had a positive, yet weak correlation with learning styles relying on the right brain. It was found in the present study that the department with the highest mathematics anxiety level was the Turkish Language Teaching and Social Studies Teaching, whereas the department with the lowest mathematics anxiety level was the Elementary School Mathematics Teaching and Psychological Counseling and Guidance. We can say that people educated in departments which require more verbal intelligence with high social intelligence have higher mathematics anxiety (with a weak correlation). However, in our country, it is also known that teaching department preferences of the students are not determined according to the intelligence areas. Although this is the case, students often choose science department, equally-weighted department and social sciences departments in high schools based on their interests and performance in lectures. Therefore, students who love and succeed numerical lessons and choose science departments and students who love and succeed verbal lessons prefer social sciences departments. It is not entirely possible to say that the success in the courses are not related to their intelligence. Also, the researcher determined that students who educated at the department of Turkish Language Teaching and social sciences department in high school had the highest LHM score, whereas students who educated at the department of Elementary School Mathematics Teaching and science department in high school had the lowest LHM score. Learned helplessness causes students to lose confidence (Diener & Dweck, 1978). This may be interpreted as that students who display learned helplessness in relation to mathematics lose confidence in their mathematical skills, and therefore these students prefer subject areas related to social sciences, which do not include mathematics. Considering prospective teachers’ PMS scores, it was observed that those from the Elementary School Mathematics Teaching department in university and the science department in high school had higher scores, while those from the Turkish Language Teaching department in university and the social sciences department in high school had lower scores. This may be interpreted as that those who studied in departments with intensive mathematics education have higher mathematical confidence and self-efficacy.

Bandura (1997) reports that decreased self-efficacy belief causes anxiety and stress in students. It was found in our study that there was a negative correlation between PMS and NA, and a positive and strong correlation between PA. The negative anxiety score was observed to decrease with increasing self-efficacy score, which may be interpreted as that individuals have lower negative anxiety as they feel more competent in mathematics. This finding is consistent with that of many other studies in the literature (Günhan-Cantürk & Başer, 2007; Hoffman, 2010; Tapia & Marsh, 2004; Yurt & Sünbil, 2014). Also, a negative and strong correlation was found between PMS and LHM. In other words, it was determined that prospective teachers’ learned helplessness decreased with increasing mathematics self-efficacy. Ekinci & Göklér (2017) found that learned helplessness decreased with increasing academic self-efficacy as well. Our finding is consistent with that of Ekinci & Göklér (2017). Another finding of our study was the positive correlation between LHM and NA, and the negative and strong correlation between LHM and PA in prospective teachers. The negative correlation of learned helplessness with positive anxiety and the positive correlation of learned helplessness with negative anxiety show that positive anxiety tends to decrease as learned helplessness increases, or learned helplessness tends to decrease as positive anxiety increases in students. In fact, this showed a bidirectional relationship between anxiety and learned helplessness, which are two affective variables.

In our study, the relationship between MA and LHM was examined within a model, and PMS was found to act as a full mediator in this relationship. This may be interpreted as that individuals who believe that who cannot solve mathematical problems and have low perceived self-efficacy develop learned helplessness in time due to experiencing negative outcomes constantly. Indeed, our findings showed that
prospective teachers from the Turkish Language Teaching department had the highest mathematics anxiety, the lowest mathematics self-efficacy, and the highest learned helplessness.

Although there are studies in the literature focusing on the linear correlation between two variables such as PMS and MA or PMS and LHM, to the best of our knowledge, there is no study in the literature focusing on the trilateral relationship between PMS, MA, and LHM, and the mediating effect of PMS. The mediating role of PMS between MA and LHM was a subject of curiosity since it is closely related to both of these variables. Different from studies in the literature, this study focused on the mediating effect of PMS in the relationship between MA and LHM in an attempt to contribute to the literature.

**Recommendations**

Studies in the literature show that students with low mathematics anxiety are more successful in mathematics compared to others, while students with high mathematics anxiety are less successful compared to others (Alkan, 2011). Also, mathematics anxiety causes tension and stress while solving problems or performing operations with numbers in both school and everyday life (Tobias, 1993). In time, this state of anxiety leads to forgetfulness and causes the individual to lose confidence (Tobias, 1993). This situation may lead to a decrease in self-efficacy levels of students in mathematics. As a result, over time the individual may have LHM (Ekinci & Gökler, 2017; Qian & Alvermann 1995). However, it is possible to mitigate, or even eliminate this anxiety through certain measures. To achieve this, it is recommended to increase the number on mathematic anxiety. Thus, effective interventions towards MA can increase the level of PMS of individuals. Trisha (1999) emphasizes that it is possible to change student attitudes for the better by developing motivating strategies and making mathematics a more enjoyable subject. Özyürek (2002) reports that one of the reasons behind students’ fear of mathematics is the teacher’s preference of traditional teaching methods. It is possible to mitigate, or even eliminate anxiety by gaining awareness regarding the effects of mathematics anxiety (Scarpello, 2007). The educators of these students can enable some motivating applications related to mathematics for these students who have NA. In this way, they can enable the removal of fear from them. Based on the idea that mathematics anxiety can be learned; Austin, Wadlington, & Bitner (2001) and Martinez & Martínez (1996) suggest that it is possible to learn how to cope with mathematics anxiety as well. Similarly, encouraging and supporting students in the way that they can succeed in mathematics-related subjects can increase students’ self-efficacy beliefs. Similarly, encouraging and supporting students in the way that they can succeed in mathematics-related subjects by the their teachers can increase students’ PMS beliefs and this situation can provide loss of anxiety and increase the success.
REFERENCES


