



Research Article

Pre-service Mathematics Teachers' Professional Self-Esteem and Beliefs about the Nature of Mathematics

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Received : 08.11.2021

Accepted : 29.11.2021

Doi: 10.17522/balikesirnef.1020701

Abstract –This study aims to examine the professional self-esteem of pre-service primary school mathematics teachers in the context of their beliefs about the nature of mathematics. The study has a quantitative design and 220 pre-service mathematics teachers voluntarily participated in the study. In the data analysis of this study based on a quantitative research design, independent samples t-test, one-way ANOVA and multiple regression analyzes were performed and the Pearson correlation coefficient was determined. According to the findings of the study, professional self-esteem and belief about the mathematics' nature are not affected by gender and grade level. In addition, professional self-esteem of the pre-service teachers who believe that mathematics is a branch of science open to exploration, knowledge generation, and related to other sciences and daily life, may be said to be higher-positive than the professional self-esteem of the pre-service mathematics teachers who perceive mathematics as a set of unrelated concepts and formulas or believe that mathematics is a deductive and precise body of knowledge.

Key words: professional self-esteem, beliefs on the nature of mathematics, pre-service mathematics teachers

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Introduction

Teaching is accepted as a profession that requires high qualifications that can fully bear the responsibility of human life (Ministry of National Education (MNE), 2017, p.2). It is a known fact that teachers, who are the most vital element of the education system, should have high qualifications to meet these responsibilities and expectations. And this requires them to be individuals who are open to continuous development. Among these high qualifications, besides

professional knowledge and skills, the "attitude and values" competence expects teachers to respect individual and cultural differences, value each student, be a role model for students with their attitudes and behaviors, be empathetic and tolerant in human relations, do their profession lovingly and willingly, to make self-evaluation, be open to communication and cooperation, to protect professional commitment and dignity by complying with professional, ethical principles and more (MNE, 2017). These concepts and principles (competence indicators) are closely related to how the teacher perceives themselves and their profession and how s/he values their profession, in other words, the professional self-esteem of the teacher. On the other hand, the necessity of teachers to have particular competencies in the field they teach requires a mathematics teacher to ensure professional development as a mathematics teacher and to have attitudes and values in the context of mathematics teaching. This raises the question of whether the value and dedication a mathematics teacher attributes to the teaching profession in the context of professional self-esteem are affected by the nature of mathematics. Beliefs about mathematics' nature, in fact, form the basis of beliefs about learning and teaching mathematics (Dede & Karakuş, 2014). And this then affects teachers' instructional behaviors and decisions about teaching (Abrosse et al., 2004; Handal, 2003; Thompson, 1992). This study aims to examine the professional self-esteem of pre-service primary school mathematics teachers in the context of their beliefs about the nature of mathematics. The study examined whether gender and grade level variables made a difference in pre-service teachers' beliefs about the nature of mathematics and their professional self-esteem levels. The relationship between belief in the mathematics' nature and professional self-esteem was investigated.

Self-Esteem and Professional Self-Esteem

Self-esteem is an individual's evaluation of his or her own self. There are common elements used in the literature to define this concept. These elements make up the concept of competence, respect, worthiness, identity, belonging, security, etc. (Tabassum & Ali, 2012). Another important concept that can be evaluated as a reflection of self-esteem in an individual's life is professional self-esteem. The value and importance that an individual attributes to a profession is named professional self-esteem, even if it does not turn into a preference for herself/himself (Arıcak & Dilmaç, 2003). Arıcak (1999) defined occupational self-esteem as "the individual's judgment of worthiness formed regarding the self-attributions accepted by the individual as related to the profession, whether or not it was transformed into a professional preference". It is stated that professional self-esteem is closely related to professional adaptation and professional satisfaction (Arıcak & Dilmaç, 2003). In fact, it was determined that pre-

school teachers with positive professional self-esteem had developed empathic skills (Ceylan et al., 2009) that empathy is an essential skill for teachers to respond to the individual needs and differences of students. On the other hand, in a study conducted with teachers, it is found that professional self-esteem is closely related to professional burnout (Khezerlou, 2017). Khezerlou (2017) stated that this result means that a teacher with positive professional self-esteem will experience less emotional exhaustion, suffer less depersonalization, and spend more effort to succeed in their profession and improve themselves. On the other hand, it was determined that pre-active teachers with high professional self-esteem had increased life satisfaction (Aktac & Cetinkaya, 2019).

When examining the literature, it can be thought that there are more studies on teachers' professional self-esteem in the national literature compared to the international literature. It can be said that studies on professional self-esteem generally focus on health and education (e.g., Efiltili & Çıkılı, 2017; Varol et al., 2020; Polat & Balaban, 2021). It is possible to say that especially pre-school (Polat & Balaban, 2021), special education (Efiltili & Çıkılı, 2017), music (Tokinan, 2013), science (Aktac & Çetinkaya, 2019), physical education, information technologies (Dursun et al., 2014) and primary education (Ünal & Şimsek, 2008), secondary education (Tabassum & Ali, 2012) teachers or pre-service teachers are studied in this field. While some of these studies directly examine the professional self-esteem of teachers or pre-service teachers, some of them examine professional self-esteem, self-esteem, attitude towards the profession (Altunay & Yazıcı, 2021), the type of appointment to the teaching profession (Kurt & Demirpolat, 2020), professional resilience belief (Dönmez & Kavuncuoğlu, 2019), professionalism (Polat & Balaban, 2021), and life satisfaction (Aktac & Çetinkaya, 2019). It is possible to say that the study is new to the literature in terms of examining pre-service mathematics teachers' professional self-esteem by associating it with their belief in mathematics' nature.

Beliefs about the Nature of Mathematics

Beliefs are essential in learning and teaching mathematics (Ernest, 1989; Pajares, 1992; Thompson, 1992). Although there is no clear definition of belief in the literature (Beswick, 2005; McLeod & McLeod, 2002; Thompson, 1992), Philipp (2007) defined belief as understanding, assumption, or proposition that is considered to be true, and similarly, Richardson (1996) considered it as propositions that a person thinks to be true, Ponte (1994) as a phenomenon with solid emotional and selective components, which is a part of knowledge and shaped by experiences. Thompson (1992) claimed that belief equates to concepts,

meanings, propositions, rules, or mental images, while Schoenfeld (1985) stated that belief represents perceptions and cognitions. The common view in the definitions of belief in the literature is that belief is shaped by experiences (Ponte, 1994), it is personal (Philipp, 2007), it is based on emotional and cognitive (Pehkonen, 2004) foundations and can affect behaviors (Pajares, 1992; Philipp, 2007).

Belief in mathematics was expressed as reflecting experiences related to mathematical concepts (Hart, 1989; Thompson, 1984) and personal evaluations based on past experiences related to mathematics (Raymond, 1997). Researchers (Raymond, 1997; Op't Eynde et al., 2002) consider mathematical belief as beliefs about the nature of mathematics, learning, and teaching mathematics. Belief in the mathematics' nature is concerned with what mathematics does and its quality (Dede & Karakuş, 2014; Ernest, 1989). It was claimed that these types of beliefs are related to each other, and that belief in the nature of mathematics forms the basis of beliefs about learning and teaching mathematics (Dede & Karakuş, 2014; Philipp, 2007; Richardson, 1996; Thompson, 1992). Pajares (1992) emphasized that teachers' beliefs affect their perceptions, decisions, and performance in the lesson. Examining teachers' beliefs about mathematics can reveal their classroom activities, teaching processes, and classroom performances (Handal, 2003; Irez, 2007; Philippou & Christou, 1999). In that case, it is a matter of curiosity whether the belief in the mathematics' nature affects professional self-esteem (Altunay & Yazıcı, 2021), which affects the attitude towards the profession and motivation. In this sense, in the present study, determining the professional self-esteem of pre-service primary school mathematics teachers, who are the teachers of the future, in the context of their beliefs about the nature of mathematics was found to be important in terms of determining the possible effects of belief in the nature of mathematics, better recognizing the factors affecting professional self-esteem and making inferences for teacher education.

In this context, the questions to be answered in the study are:

1. Do primary school mathematics pre-service teachers' professional self-esteem and beliefs about the nature of mathematics differ significantly according to gender?
2. Do primary school mathematics pre-service teachers' professional self-esteem and beliefs about the nature of mathematics differ significantly according to grade level?
3. What is the relationship between primary school mathematics pre-service teachers' professional self-esteem and their beliefs about the nature of mathematics?
4. Do primary school mathematics pre-service teachers' beliefs about the nature of mathematics predict their professional self-esteem?

Method

Research Design

In this study, the survey model, one of the quantitative research methods, was used in the data collection process. The preferred survey model is the cross-sectional survey model (Fraenkel et al., 2012), in which the data are collected from the sample at once, and the relational survey model.

Sample Group

The study sample consisted of 220 pre-service teachers studying in the Department of Primary Mathematics Education of a university in the west of Turkey in the 2019-2020 spring semester. Of the 174 female and 46 male pre-service teachers, 60 are in the first grade, 47 are in the second grade, 57 are in the third grade, and 56 are in the fourth grade. Since the sample selection in the research is vital in representing the research results or significance in similar situations, the study group was determined according to the purposive sampling method, which is one of the non-random sampling methods. Here, too, the easily accessible case sampling method was preferred based on voluntariness. In the easily accessible sampling method, the researcher chooses close and easy to reach people for speed and practicality purposes (Merriam, 2009). Accordingly, all pre-service teachers studying in a mathematics education undergraduate program of a faculty were sent an invitation to participate, only 220 pre-service teachers volunteered to participate in the study.

Data Collection Tools and Process

In the study, validity and reliability studies were conducted as data collection tools, and two different scales were used: the "Professional Self-Esteem Scale" developed by Arıcak (1999) and the "Belief Scale About the Nature of Mathematics" developed by Akyıldız and Dede (2019).

Mathematics Self-Esteem Scale: This scale, developed by Arıcak (1999), consists of 30 items. 14 of these items contain positive and 16 negative statements. The scale is in 5-point Likert type as "Strongly Agree (5)", "Agree (4)", "Undecided (3)", "Disagree (2)", and "Strongly Disagree (1)". The lowest score possible on the scale is 30, and the highest score is 150. The scale has three dimensions: "Accepting the Profession", "Valuing the Profession", and "Belief in the Functionality of the Profession". The scale was applied to the study group to re-determine the validity and reliability values and the Cronbach alpha reliability coefficient was determined to be .92.

The scale of Belief in the Nature of Mathematics: This scale, developed by Akyıldız and Dede (2019), consists of 41 items. The scale is in 5-point Likert scale as "Strongly Agree (5)", "Agree (4)", "Undecided (3)", "Disagree (2)" and "Strongly Disagree (1)". High scores obtained from the scale represent more advanced beliefs about the nature of mathematics. The scale has two dimensions: "Associated Belief" and "Dissociated Belief". Associated belief encompasses progression-oriented mathematics and function-oriented mathematics viewpoints obtained from semantic content analysis, while dissociated belief encompasses tool-oriented mathematics and goal-oriented mathematics perspective. Progress-oriented belief is focused on discovering mathematics and producing knowledge and is intertwined with other sciences. Function-oriented belief evaluates mathematics as a tool in daily life and is used to meet daily life needs. Tool-oriented belief, on the other hand, considers mathematics as the sum of unrelated concepts, operations, formulas, and rules, whereas goal-oriented belief considers mathematics as a systematic and completely abstract science consisting of definite information based on deduction (Akyıldız & Dede, 2019). The scale was applied to the study group to re-determine the validity and reliability values, and the Cronbach alpha reliability coefficient was found to be 84.

The study data were collected in the 2019-2020 spring semester, which coincided with the pandemic. Since the universities had distance education then, the pre-service teachers' data were collected via e-mail. The scales used in the study were created on the Google Forms platform and sent to the pre-service teachers' e-mails, and the researcher informed them about the voluntary basis and the confidentiality of the participants. In addition, the researcher stated that there is no time limit for the pre-service teachers to answer the items on the scale. It was accepted that the pre-service teachers answered the statements on the scale correctly and sincerely.

Data Analysis

SPSS 20.0 package program was used to analyze this research, which has a quantitative research design. In this study, independent samples t-test was used to determine the total scores of the participants' professional self-esteem and beliefs about the nature of mathematics and the scores of its sub-dimensions differed significantly by gender, One Way ANOVA was used to reveal whether there was a significant difference between the total scores and sub-dimensions of pre-service mathematics teachers' professional self-esteem and belief in mathematics in terms of grade level, and correlation analysis was used to determine the relationships between the pre-service mathematics teachers' beliefs about the nature of mathematics and their professional

self-esteem and its sub-dimensions were conducted. In addition, multiple regressions were conducted to determine the predictive power of pre-service teachers' beliefs about the nature of mathematics, associated and dissociated belief sub-dimensions on the professional self-esteem.

Findings

Whether pre-service teachers' professional self-esteem and beliefs about the nature of mathematics differed significantly according to gender and grade levels was determined by one-way ANOVA in this study. In addition, the correlation between pre-service teachers' professional self-esteem and their beliefs about the nature of mathematics was analyzed by correlation.

Investigation of Pre-service Teachers' Professional Self-Esteem and Beliefs on the Nature of Mathematics in Terms of Gender Variable

Whether the total scores of the participants' professional self-esteem and beliefs about the nature of mathematics and the scores of its sub-dimensions differed significantly by gender was determined by the Independent samples t-test (Table 1).

Table 1. Descriptive Statistics Results on Occupational Self-Esteem and Its Sub-Dimensions in terms of Gender and Belief in the Nature of Mathematics and its Sub-Dimensions

| The scales | Sub-Dimensions | Gender | N | \bar{X} | Ss | df | t | p |
|--------------------------|--|--------|-----|-----------|----------|-----|-------|------|
| Professional Self-Esteem | Accepting the job | Female | 174 | 54,5115 | 54,5115 | 21 | 1,106 | ,270 |
| | | Male | 46 | 53,0217 | 9,40801 | 8 | | |
| | Valuing the profession | Female | 174 | 41,8391 | 4,57531 | 21 | 2,631 | ,009 |
| | | Male | 46 | 39,7174 | 5,84109 | 8 | | |
| | Believing in the functionality of the profession | Female | 174 | 24,6667 | 2,76295 | 21 | 1,030 | ,304 |
| | | Male | 46 | 24,1739 | 3,31531 | 8 | | |
| Total | | Female | 174 | 121,0172 | 13,57892 | 218 | 1,737 | ,084 |

| | | | | | | | | |
|-------------------------------------|--------------------|--------|-----|----------|----------|----|--------|------|
| | | Male | 46 | 116,9130 | 16,57284 | | | |
| Belief in the nature of mathematics | Associated Belief | Female | 174 | 119,0920 | 11,64368 | 21 | 2,584 | ,010 |
| | | Male | 46 | 114,2826 | 9,45554 | 8 | | |
| | Dissociated belief | Female | 174 | 35,9253 | 5,21782 | 21 | -1,835 | ,068 |
| | | Male | 46 | 37,6087 | 6.60800 | 8 | | |
| Total | | Female | 174 | 155,0172 | 12,17762 | 21 | 1,591 | ,113 |
| | | Male | 46 | 151,8913 | 10,51608 | 8 | | |

* $p < .05$, $p > .05$

As seen in Table 1, the mean of professional self-esteem of the females in the total score ($\bar{X} = 121.01$), is higher than the mean of males ($\bar{X} = 116.913$). However, this difference between occupational self-esteem total scores by gender is insignificant, $t(218) = 1.737$, $p > .05$. The average of the females' scores in professional acceptance, which is the sub-dimension of professional self-esteem ($\bar{X} = 54.51$), is higher than the mean of males ($\bar{X} = 53.02$). However, the difference between the total scores in this sub-dimension according to gender is insignificant, $t(218) = 1.106$, $p > .05$. The average of the females believing in the functionality of the profession, one of the sub-dimensions of professional self-esteem ($\bar{X} = 24.66$), is higher than the mean of males ($\bar{X} = 24.17$). However, the difference between the total scores in this sub-dimension according to gender is also insignificant, $t(218) = 1.030$, $p > .05$. The average of females valuing the profession, one of the sub-dimensions of professional self-esteem ($\bar{X} = 41.83$), is higher than the mean of males ($\bar{X} = 39.71$). The difference between the total scores of only this sub-dimension according to gender is significant, $t(218) = 2.631$, $p < .05$. Therefore, valuing the profession only in the sub-dimension for professional self-esteem varies between females and males; that is, females value their profession more than males. The effect of gender on professional self-esteem r^2 was calculated as $r^2 = 0.013$. According to this, 1.3% of the variance in the professional self-esteem of pre-service teachers was due to gender. According to Cohen (1988), this was accepted as a minor effect.

As seen in Table 1, the average of the females in total scores in belief in the nature of mathematics ($\bar{X} = 155.01$), is higher than the mean of males ($\bar{X} = 151.89$). However, this

difference between the total scores in belief in the nature of mathematics by gender is insignificant, $t(218) = 1.591, p > .05$. The average of the females' scores in dissociated belief, which is the sub-dimensions of belief in the nature of mathematics ($\bar{X} = 35.92$), is lower than the average of males ($\bar{X} = 37.60$). However, the difference between the total scores in this sub-dimension according to gender is insignificant, $t(218) = 1.106, p > .05$. The average of the females' scores in the associated belief, which is one of the sub-dimensions of belief in the nature of mathematics ($\bar{X} = 119.09$), is higher than the average of males ($\bar{X} = 114.28$). The difference between the total scores of only this sub-dimension according to gender is significant, $t(218) = 2.631, p < .05$. Therefore, from the belief about the nature of mathematics, only the associated belief differs between females and males; that is, girls think mathematics is more progress-oriented and function-oriented than boys do. The effect of gender on belief in the nature of mathematics r^2 was calculated $r^2 = 0.011$. Accordingly, 1.1% of the variance in the pre-service teachers' belief in the nature of mathematics originated from gender. According to Cohen (1988), this was accepted as a minor effect.

Investigation of Pre-service Teachers' Professional Self-Esteem and Beliefs on the Nature of Mathematics in Terms of Gender Variable

A One-Way ANOVA analysis was used to reveal whether there was a significant difference between the total scores and sub-dimensions of pre-service mathematics teachers' professional self and belief in mathematics in terms of grade level (Table 2).

Table 2. One-Way ANOVA Results on Occupational Self-Esteem and Its Sub-Dimensions and Belief in the Nature of Mathematics and Sub-Dimensions Scores in Terms of Grade Level

| The scales | | | | | | | |
|--------------------------|-------------------|------------|----------------|-------|--------------------|-------|-------|
| | Sub-Dimensions | References | Sum of squares | of Sd | Average of Squares | F | p |
| Professional Self-Esteem | Accepting the job | Intergroup | 551,779 | 3 | 183,926 | 2,853 | ,038* |
| | | In-group | 13923,421 | 216 | 64,460 | | |
| | | Total | 14475,200 | 219 | | | |
| Valuing the profession | the | Intergroup | 148,159 | 3 | 49,386 | 2,062 | ,106 |
| | | In-group | 5172,437 | 216 | 23,946 | | |
| | | Total | 5320,595 | 219 | | | |
| Believing in the | the | Intergroup | 10,015 | 3 | 3,338 | ,397 | ,755 |

| | | | | | | | |
|---|-----------------------|-----------|-----------|-----|---------|-------|-------|
| functionality of the profession | In-group | 1814,094 | 216 | | | | |
| | Total | 1824,109 | 219 | | | | |
| | Total | Intergrup | 1183,704 | 3 | 394,568 | 1,951 | ,122 |
| | | In-group | 43687,728 | 216 | 202,258 | | |
| | | Total | 44871,432 | 219 | | | |
| Belief in the nature of mathematics | Associated Belief | Intergrup | 914,779 | 3 | 304,926 | 2,403 | ,069 |
| | | In-group | 27404,580 | 216 | 126,873 | | |
| | | Total | 28319,359 | 219 | | | |
| | Dissociated Belief | Intergrup | 567,299 | 3 | 189,100 | 6,577 | ,000* |
| | | In-group | 6210,787 | 216 | 28,754 | | |
| | | Total | 6778,086 | 219 | | | |
| Total | | Intergrup | 786,205 | 3 | 262,068 | 1,874 | ,135 |
| | | In-group | 30200,704 | 216 | 139,818 | | |
| | | Total | 30986,909 | 219 | | | |

* $p < .05$, $p > .05$

As seen in Table 2, the total mean score of professional self-esteem of pre-service teachers did not show significant differences according to grade level ($p > .05$). When the sub-dimensions of professional self-esteem were examined, a significant difference was observed in accepting the profession according to the grade level ($p < .05$), but no significant difference was observed in other sub-dimensions according to grade levels. It was determined that the total score of belief in the nature of mathematics did not differ significantly according to grade levels ($p > .05$). There was a significant difference between the pre-service teachers according to the grade level in dissociated belief, one of the sub-dimensions of the belief in the nature of mathematics ($p < .05$), but no significant difference was observed in associated beliefs according to grade level ($p > .05$). Which of the post-hoc multiple comparison techniques will be used to determine the difference between the scores in accepting the profession and dissociated belief according to grade levels was decided by the Levene test, and it was determined that the variances in accepting the profession were not homogeneous. For this sub-dimension, $F(3, 216) = 3.713$, $p > .05$ value was found. Dunnett C test results were used to find the source of the difference

between the groups. The results revealed a significant difference between 1st and 4th grades in accepting the profession, in favor of 4th graders, $p < .05$. In other words, 4th graders accepted the profession more than 1st graders. As for dissociated belief, since the variances are homogeneous, $F(3, 216) = 0.769$, $p > .05$ values were reached. In this case, Tukey test results from post-hoc multiple comparison analyzes were examined to find the source of the difference between the groups. The results revealed a significant difference between the 2nd and 3rd grades in favor of the 2nd grade and between the 2nd and 4th grades in favor of the 2nd grade, $p < .05$. In other words, 2nd graders thought that mathematics was more means and ends-oriented than 3rd and 4th graders.

Investigation of the Relationship Between Pre-service Teachers' Professional Self-Esteem and Beliefs on the Nature of Mathematics

The Pearson Correlation Coefficient was calculated to determine the relationships between the education faculty students' beliefs about the nature of mathematics and their professional self-esteem and its sub-dimensions (accepting the profession, valuing the profession, and believing in the functionality of the profession). The analysis results are in Table 3.

Table 3. Results Regarding the Determination of the Relationship Between Belief in the Nature of Mathematics and Professional Self-Esteem and Its Sub-Dimensions by Pearson Correlation Coefficient

| | | Belief in the nature of mathematics | Associated Belief | Dissociated belief |
|--------------------------|--|-------------------------------------|-------------------|--------------------|
| The scales | | | | |
| Professional Self-Esteem | | .369** | .449** | -.129 |

* $p < 0.05$

As seen in Table 3, there is a positive but weakly significant ($r = .369$, $p < .05$) relationship between pre-service teachers' professional self-esteem and their total beliefs about the nature of mathematics. In addition, there is a positive but weakly significant ($r = .449$, $p < .05$) relationship between professional self-esteem and associated belief, and a negative weakly insignificant ($r = -.129$, $p > .05$) relationship between dissociated belief.

Investigation of Pre-service Teachers' Beliefs on the Nature of Mathematics Predicting Professional Self-Esteem

Multiple regressions were performed to reveal the effect of the change in beliefs about the nature of mathematics and its sub-dimensions (associated and dissociated beliefs) on the professional self-esteem of pre-service teachers (Table 4).

Table 4. Multiple Regression Analysis Results on the Prediction of Belief in the Nature of Mathematics on Occupational Self-Esteem

| Variable | B | Std. Error | Std. Beta | t | p | R | R ² |
|-------------------------------------|-------|------------|-----------|--------|------|------|----------------|
| Belief in the nature of mathematics | .444 | .076 | .369 | 5.865 | .000 | .369 | .136 |
| Associated Belief | .566 | .076 | .449 | 7.427 | .000 | .449 | .202 |
| Dissociated Belief | -.332 | .173 | -.129 | -1.923 | .056 | .129 | .017 |

As seen in Table 4, when the multiple regression analysis of belief in the nature of mathematics and the sub-dimensions associated belief and dissociated belief predict professional self-esteem, it was found that belief in the nature of mathematics predicted professional self-esteem statistically ($F= 34,401$, $R= .369$, $R^2= .136$, $p<.05$). Accordingly, it was observed that belief in the nature of mathematics explained approximately 13% of the total variance regarding professional self-esteem. In other words, as pre-service teachers' beliefs about the nature of mathematics increase, their professional self-esteem also increases. In addition, while the associated belief, one of the sub-dimensions of belief in the nature of mathematics, statistically predicted professional self-esteem ($F= 55.161$, $R= .449$, $R^2= .202$, $p<.05$), dissociated belief was not a statistically significant predictor ($F= 3.699$, $R= .129$, $R^2= .017$, $p>.05$). These findings were found to explain approximately 20% of the total variance regarding professional self-esteem. In other words, as the associated beliefs of pre-service mathematics teacher increase, their professional self-esteem also increases.

Discussion, Conclusion, and Suggestions

The current study examined the professional self-esteem of primary school mathematics pre-service teachers in the context of their beliefs about the nature of mathematics. When their professional self-esteem was evaluated independently of their beliefs about the nature of mathematics, it was determined that gender did not influence the professional self-esteem of primary school mathematics teachers. These results differ from the results of the research in the literature that female teachers develop more positive professional self-esteem than male teachers (Güleç & Özbek Ayaz, 2017; Tabassum & Ali, 2012; Ünal & Şimşek, 2008). Although few, it should be said that there are also studies supporting that professional self-esteem does not make a difference between the genders (e.g., Dursun et al., 2014; Efiltili & Exit, 2017). However, in this study, a difference was found in favor of female pre-service mathematics

teachers valuing the profession dimension, a sub-dimension of professional self-esteem. In this context, it is possible to say that female mathematics pre-service teachers value the profession more than males. In studies claiming that gender is a variable that makes a difference, females' professional self-esteem was found to be higher in general (Güleç & Özbek Ayaz, 2017; Tabassum & Ali, 2012; Ünal & Şimşek, 2008). However, in the study conducted by Yıldırım et al. (2010), the professional self-esteem of male physical education teachers was found to be higher than that of females. These results raise the question of whether the effect of gender on professional self-esteem is related to the subject of teaching. However, no significant difference was found in the professional self-esteem of the candidates according to their grade levels. This is consistent with Tokinan's (2013) study results that teaching experience and practice courses do not affect the professional self-esteem of pre-service music teachers. At the same time, this finding can be evaluated as consistent with the conclusion that the affective education course taught with creative drama does not significantly influence the professional self-esteem of pre-service teachers, as observed in the study conducted by Akdemir (2020). However, as the grade level progressed, it was observed that the pre-service teachers' professional acceptance increased. This means that pre-service teachers accept the profession more over time and with the education they get in faculties. Therefore, although it does not affect valuing the profession and believing in its functionality, it may suggest that undergraduate education has an effect on accepting the profession.

Examining a pre-service mathematics teacher's professional self in the context of his belief in the nature of mathematics is important in showing whether the belief in the nature of mathematics will affect the perception of mathematics teaching and the professional attitudes and behaviors of the individual. According to the current study's findings, it can be said that belief in the nature of mathematics significantly predicts professional self-esteem, and there is a significant but weak relationship between them. In particular, it was determined that dissociated beliefs did not predict professional self, and there was no relationship between them. It was determined that associated belief influences professional self-esteem, and there is a significant but weak relationship between them. When these results are interpreted according to Akyıldız and Dede's (2019) definition of belief in the nature of mathematics, it can be concluded that the professional self-esteem of pre-service teachers who have a progression and function-oriented mathematics perspective is higher than that of who have a means and end-oriented mathematics perspective. This means that pre-service teachers who believe that mathematics is a branch of science that is open to exploration, knowledge generation, and

related to other sciences and daily life have more positive professional self-esteem. On the other hand, it can be said that the professional self-esteem of the pre-service teachers who perceive mathematics as a set of unrelated concepts and formulas or who believe that mathematics is a deductive and definite body of knowledge is lower than the other pre-service teachers. Therefore, the finding that a pre-service teacher's belief influences professional self-esteem, which influences many other factors such as enjoying life, empathy skills, attitude towards the profession, and professional burnout, is significant. However, when the pre-service teachers' beliefs about the nature of mathematics are evaluated within themselves, it can be said that pre-service female teachers have more associated beliefs than males; that is, they believe that mathematics focuses on progress and function. It was observed that the dissociated belief with a tool-oriented and goal-oriented mathematics perspective adopted by pre-service mathematics teachers at the 2nd-grade level decreased in the pre-service teachers of the 3rd and 4th grades. As the grade level progresses, the decrease in the level of dissociated beliefs can be perceived as a positive result in the belief in the nature of mathematics in professional self-esteem. Considering that the acceptance of the profession and the tendency to associated beliefs increase according to the grade level, these results may suggest the positive effect of the undergraduate education received. As mentioned before, teachers need to have positive professional self-esteem to have the professional competencies determined by the Ministry of National Education (2017), fulfill their responsibilities, improve themselves, and be motivated for this. Based on the conclusion that the belief in the nature of mathematics obtained through the study influences professional self-esteem, it is considered important to systematically plan and employ teaching and practices that will positively affect the belief in the nature of mathematics as well as the view on the profession in teacher education. As a matter of fact, it is known that teacher education affects teachers' beliefs in mathematics (Raymond, 1993).

The question of why female pre-service mathematics teachers values the profession more than males and have an associated belief about the nature of mathematics, obtained in this study, can be answered with qualitative studies that illuminate these quantitative data. It can be thought that the different effects of gender on occupational self-esteem observed in the literature may be affected by the culture of belonging or the micro-culture created by people belonging to the profession. As a matter of fact, it can be thought that professional self-esteem, which is the subject of an affective field, may be influenced by the personal experiences of the individual and the culture of the society in which s/he lives. In this context, studies examining prospective teachers' professional self-esteem and beliefs about the nature of mathematics in different cultures are important to observe the effect of culture on concepts. In addition, studies aimed at

understanding the relationship between professional self-esteem and important affective factors such as social and socio-mathematical norms and values that may affect professional self-esteem are valuable in terms of improving the quality of undergraduate education in this direction.

Matematik Öğretmen Adaylarının Mesleki Benlik Saygısı ve Matematiğin Doğasına Yönelik İnançları

Özet:

Bu çalışmanın amacı ilköğretim matematik öğretmen adaylarının mesleki benlik saygılarının adayların matematiğin doğasına ilişkin inançları bağlamında incelenmesidir. Çalışma nicel tasarıma sahiptir ve 220 öğretmen adayı çalışmaya gönüllü olarak katılmıştır. Çalışmanın veri analizinde bağımsız örneklem t testi, tek yönlü ANOVA ve çoklu regresyon analizleri yapılmış ve pearson korelasyon katsayısı belirlenmiştir. Araştırmada elde edilen bulgulara göre, mesleki benlik saygısı ve matematiğin doğasına yönelik inancın cinsiyetten ve sınıf düzeyinden etkilenmediği tespit edilmiştir. Ayrıca matematiğin keşfetmeye, bilgi üretmeye açık, diğer bilimlerle ve günlük hayatla ilişkili bir bilim dalı olduğuna inanan öğretmen adaylarının mesleki benlik saygılarının, matematiği ilişkisiz kavramlar, formüller bütünü olarak algılayan veya matematiğin tümdengelimli, kesin bilgiler bütünü olduğuna inanan adayların mesleki benlik saygılarından daha olumlu olduğu söylenebilir.

Anahtar kelimeler: mesleki benlik saygısı, matematiğin doğasına yönelik inanç, matematik öğretmen adayları

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