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Mathematics Education Values Portrayed by Elementary Student Teacher*

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Abstract

This study aims at investigating values in mathematics education portrayed by elementary student teachers. Data were gathered from 401 elementary student teachers at two public universities in Turkey. The results of the study showed that overall student teachers had positive mathematics education values. They recognized that the theoretical nature of mathematics apart from its relations to daily life would be meaningless. However, they held negative mathematics education values regarding conceptual learning of mathematics. They also recognized how important it was to emphasize the affective and cognitive outcomes in mathematics programs. The findings showed that no significant differences between student teachers' mathematics education values regarding gender and year spent in the program. However, significant differences were found in theory emphasis mathematics teaching favoring female student teachers.

Keywords: Mathematics, Education, Values, Elementary, Student Teacher

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Introduction

Values are at the heart of teaching mathematics (Bishop, Seah & Chin, 2003) since teachers' values play a fundamental role in education landscape. Values in mathematics education are defined as deep affective qualities that are an essential part of the classroom environment (Bishop, 2002; Bishop, 2016; Bishop, FitzSimons, Seah, & Clarkson, 1999; Dede, 2011; Seah & Wong, 2012). Also, values can be defined as individual's preference for addressing whether an idea and statement are essential and worthwhile (Chin & Lin, 2001; Seah, 2002; Swadener & Soedjadi, 1988). Values held by student teachers influence how they perceive teaching and learning mathematics (Bishop, Gunstone, Clarke & Corrigan, 2006). For instance, being or not being able to succeed in mathematics affects the student teachers' feelings towards this subject. If the student teachers are actively involved in their learning process, they develop positive feelings towards mathematics. When the student teachers develop negative feelings towards mathematics, these emotions are often influenced by the inappropriate values promoted in mathematics classrooms (Andersson, 2011). In the same way, prior experiences as a student affect the student teachers' perspectives on learning and teaching appropriate values in mathematics. Therefore, it is essential to identify student teachers' values related to mathematics teaching since these values might affect how they would teach mathematics to their students in the future. Also, identifying their values would enable us as a teacher educator to explore what mathematics could offer to people and culture through student teachers as a future elementary teacher.

Culturally, people value mathematics for different reasons since values derive from qualities in classroom and society. For instance, Bishop (1991b) posited that a parent considers mathematics crucial for his/her child to study to have a good job in the future. On the other hand, the child may want to study mathematics for enjoyment in exploring abstract ideas. The teacher may want to teach mathematical concepts for the rigorous training of mind to develop in young students. In some cultures, mathematics is valued because of the perceived qualities at different levels of social grouping. For instance, in western industrialized societies, mathematical credentials are highly valued due to fact that it leads to prestigious jobs. At the institutional level, mathematical qualifications and success are important for individuals to progress through wide range of fields in higher education. As it can be seen, people (e.g, parents, students, student teachers and teachers) value mathematics for different reasons. (Seah, 2003; Seah, Andersson, Bishop & Clarkson, 2016; Seah & Peng, 2012).

Values in mathematics education emphasize three constructs. These are rationalism-objectivism, control-progress, and openness-mystery (See more details in Bishop 1991a, 1991b). Rationalism entails abstractions, explanations, and theories that have been guiding principles of mathematical development. Therefore, it is critical for student teachers to be aware and appreciative of theoretical aspects of mathematics as well as be able to explain the significance to their students in the future. Without understanding of abstractness and logics of mathematics, language and symbols would

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be meaningless and foreign to students in that culture. In that sense, logical connections should be developed through mathematical ideas involving poofs, examples, counterexamples, and generalizations. It is also essential to reduce the theoretical nature when teaching the essential components in mathematics (Dede, 2011). When this is accomplished, students develop strong feelings of control, security and mastery (Bishop, 1991a). These complementary pairs control and progress as the attitudinal values drive the mathematical development. For instance, solution of a mathematical problem can be explained in relation to abstract nature of mathematics. In some cases, this solution can be generalized for other problems. But sometimes generalization cannot be applied when progress occurs. In addition, two sets of values, openness and mystery acquire mathematical knowledge of the students. Openness involves truths, propositions and ideas about mathematics. This means the students could examine and verify the truth about any mathematical propositions both theoretically and practically. Although both openness and mystery rely on the abstract nature of mathematics, mystery is associated with students who generate the knowledge and ideas. It is vital for the students to feel that mathematics is important to develop 'good' values (Bishop, 1991b). A good teacher should encourage students to demonstrate and explain, "why mathematical truth is so, rather than merely accepting a reason such as it looks as if it is true" (p.76, Bishop, 1991a). In order to develop 'good' values in the students, the teacher should be able to create alternative and rational solutions to mathematical problems. Especially considering young children's values are defined by their experiences in life as well as by the significant individuals that they interact with (Bishop, Seah & Chin, 2003), the student teachers, as the future elementary teacher, hold an important role in determining the values that would be internalized by the young students. Consequently, students would change or alter personal values as a result of these life experiences. According to the study of Orlich et al. (1990), elementary teachers are involved in as many as 1000 minor or major decision-making processes on a daily basis. It seems values have a great influence on what we learn and how we recognize mathematical concepts depending on the values taught in classrooms (Clarkson et al., 2001). Also, an individual's values develop from different experiences in life. As his/her experiences accumulate and change, individual's values would be modified (Raths, Harmin & Simon, 1966). Instead of making mathematics classes value-and culture-free, as a part of their preparation in teacher education programs, elementary student teachers have a great opportunity to instill desirable values in their students. Mathematics education values portrayed by student teachers are shaped and altered in relation to prior experiences gained in mathematics classroom as a student. Also, the student teachers gain different experiences by taking particular courses such as mathematics education method courses, practicum, and field experiences. As a result of these experiences, student teachers might modify their values for effective mathematics teaching. Therefore, it is important to examine student teachers' values related to mathematics teaching before they become elementary teachers.

Research studies focusing on mathematics education values include understanding of teachers'

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values in relation to effective learning and teaching (Clarkson et al. 2010; Clarkson et al. 2019; Seah & Peng, 2012; Seah et al. 2016). The results of the meta-analytic research focusing on educational values (e.g., good behavior, integrity, kindness) in Turkey revealed that samples often involved elementary students, elementary teachers, principals, and parents (Gozler et al., 2020). Within this analysis, often researchers examined educational values in textbooks and courses taught in elementary school. Also, several research studies (Aydin & Sulak, 2015; Bayir, Kose & Deveci, 2016; Dilmac, Deniz & Deniz, 2009; Fidan, 2009; Memduhoglu & Yuce, 2020; Oguz, 2012) focused on examining student teachers' educational values. As it can be seen from these research studies, educational values are at the heart of the teaching of subjects at the elementary grade level in Turkey. Research studies focused on examining mathematics education values in Turkey conducted with students (Dede 2006, 2019) and teachers (Aktas & Argun, 2018; Aktas, Yakici-Topbas & Dede, 2019; Dede, 2009, 2012, 2013, 2014, 2015) and student teachers (Dede, 2009; Durmus, 2011; McGowan & Davis, 2001; Yazıcı, et al., 2011). Also, two studies focused on developing valid and reliable instrument to measure mathematics education values (Dede, 2011; Durmus & Bicak, 2006) Results of the research studies (Dede, 2009; Durmus, 2011; Durmus & Bicak, 2006) revealed that student teachers held more constructivist values in comparison to positivist values regarding mathematics. In other words, the student teachers had a low tendency toward teacher-centered teaching approaches. Their values mirrored student-centered teaching. As it can be seen from the research, mathematics education values of Turkish elementary student teachers are neglected in the literature. Therefore, the current study aims to fill this gap by investigating mathematics education values portrayed by elementary student teachers.

Purpose

Purpose of the current study is to investigate elementary student teachers' mathematics education values. The current study aims to answer the following research questions:

1) What are the elementary student teachers' mathematics education values?

2) Is there a significant difference in mathematics education value scores of elementary student teachers regarding number of years spent in teacher education program?

3) Is there a significant difference in mathematics education value scores of elementary student teachers regarding gender?

Method

Research Design

In the present study, quantitative research design was utilized (Cohen, Manion & Morrison, 2018). The survey method approach was used to gain an overall picture of the student teachers' values in mathematics education.

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Sampling

In the present study, data were gathered from 401 (306 females and 95 males) elementary student teachers at two public universities in Turkey. The sample involves 267 fourth year and 134 third year student teachers who volunteered to participate in this study.

Data Analysis

Elementary student teachers' scores on the Mathematics Education Values Questionnaire (MEVQ) were analyzed using descriptive and inferential statistics. The normality assumptions was tested using Kolmogorov-Smirnov test since the sample of this study was larger than 50 (Demir, Saatcioglu & Imrol, 2016). Mann-Whitney U test was performed to investigate gender and year spent in the program differences in MEVQ scores of the student teachers.

Data Collection Tools

The Mathematics Education Values Questionnaire (MEVQ)

The Mathematical Education Value Questionnaire (MEVQ) developed by Dede (2011). The questionnaire was developed to examine student teachers' mathematics education values. The questionnaire includes 15 items on a five-point Likert scale. Higher scores represent positive mathematics education values. The reliability coefficient of the four subscales, theory emphasis mathematics teaching (TMT), concrete mathematics teaching (CMT), values in mathematics teaching (VMT) and affective and cognitive outcomes in mathematics teaching (ACMT) were: 0.866, 0.679, 0.708, and 0.726, respectively. The internal reliability of the MEVQ was 0.842.

Results

The distributions of the variables in the instrument were tested by using Kolmogorov-Smirnov Test. A significant result ($p<.05$) indicated that the data do not follow normal distribution. There is a violation of the assumption of normality (Pallant, 2011).

Table 1. Normality Test

	Kolmogorov-Smirnov		
Measures	Statistics	N	p
TMT	0.08	401	0.00
CMT	0.18	401	0.00
VMT	0.18	401	0.00
ACMT	0.20	401	0.00

TMT: theory emphasis mathematics teaching, CMT: concrete mathematics teaching,
VMT: values in mathematics teaching, ACTMT: affective and cognitive outcomes in mathematics teaching

Student teachers' scores on the MEVQ were analyzed to examine their mathematics education values. Means and standard deviations for each of the 4 measures appear in Table 2.

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Table 2. Means and Standard Deviations of Measures (N = 401)

Measure	M	SD
TMT	3.82	0.85
CMT	1.88	0.82
VMT	3.79	1.02
ACMT	3.82	0.98

Results of the study revealed that student teachers generally expressed positive values in mathematics education. In this study, student teachers' responses to MEVQ demonstrated positive values regarding TMT (M=3.82; SD=0.85), VMT (M=3.79; SD=1.02), and ACMT (M=3.82; SD=0.98) sub-scales. However, the student teachers' scores on CMT (M=1.88; SD=0.82) sub-scale were low.

Mann-Whitney U test was conducted to determine differences between female and male student teachers' mathematics education value scores (See Table 3).

Table 3. Mann-Whitney U results on the MEVQ

Measures	Gender	N	Mean Rank	Sum of Ranks	U	p
TMT	Female	306	207.74	63567.50	12473.50	0.036
	Male	95	179.30	17033.50		
CMT	Female	306	201.74	61732.00	14309.00	0.817
	Male	95	198.62	18869.00		
VMT	Female	306	205.15	62775.00	13266.00	0.187
	Male	95	187.64	17826.00		
ACMT	Female	306	205.20	62790.50	13250.50	0.184
	Male	95	187.48	17810.50		

TMT: theory emphasis mathematics teaching, CM: concrete mathematics teaching,
VMT: values in mathematics teaching, ACTMT: affective and cognitive outcomes in mathematics teaching

Results of the study revealed that there were no significant differences between female and male student teachers' scores regarding CMT ($p=0.817$, $p>0.05$), VMT ($p=0.187$, $p>0.05$), ACMT ($p=0.184$, $p>0.05$). However, there was a significant difference between female and male student teachers' scores regarding TMT ($p=0.036$, $p<0.05$) mathematics education values. An additional Mann-Whitney U test was conducted to determine differences between the third year and the fourth-year student teachers' mathematics education values scores (See Table 4).

Table 4. Mann-Whitney U results on the MEVQ

Measures	Year spend in the program	N	Mean Rank	Sum of Ranks	U	p
TMT	3	267	199.67	53312.50	17534.50	0.746
	4	134	203.65	27288.50		
CMT	3	267	198.46	52990.00	17212.00	0.532
	4	134	206.05	27611.00		
VMT	3	267	206.32	55087.00	16469.00	0.183
	4	134	190.40	25514.00		

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ACMT	3	267	195.80	52278.00	16500.00	0.195
	4	134	211.37	28323.00		

TMT: theory emphasis mathematics teaching, CM: concrete mathematics teaching
VMT: values in mathematics teaching, ACTMT: affective and cognitive outcomes in mathematics teaching

Results of the study revealed that there were no significant differences between the third and the fourth year student teachers regarding TMT ($p=0.746$, $p>0.05$), CMT ($p=0.532$, $p>0.05$), VMT ($p=0.183$, $p>0.05$), and ACMT ($p=0.195$, $p>0.05$) mathematics education values.

Discussion, Conclusion and Recommendations

The present study revealed that the student teachers generally expressed positive mathematics education values regarding theory emphasis mathematics teaching (TMT), values in mathematics teaching (VMT), and affective and cognitive outcomes in mathematics teaching (ACTMT). In the same way, the results of the research studies focusing on student teachers (Dede, 2009; Durmus, 2011; Durmus & Bicak, 2006) found that student teachers held positive mathematics education values. In this study, the student teachers' values on theory emphasis mathematics teaching (TMT) revealed that mathematics would be meaningful when it is taught in relation to daily life using different approaches. Dede (2015) also posited that Turkish middle and secondary mathematics teachers also preferred less emphasis on theory in mathematics teaching. As it can be seen in high VMT scores, student teachers were also aware of the fact that both textbooks and mathematics curriculum were inaccurately represented as value-free. ACMT scores revealed that student teachers also recognized the importance of highlighting both affective and cognitive learning outcomes within mathematics curriculum. However, the student teachers' score on concrete mathematics teaching (CMT) sub-scale showed that they did not hold positive values. This might mean that the student teachers did not prefer using alternative solutions in mathematics teaching. It seems they did not consider putting an emphasis on identifying the relations between the mathematical concepts as well as including activities related to daily life. Similarly, the study of McGowan and Davis (2001) showed that student teachers have learned to value, above all, getting the current answer. In addition, this study revealed that there was no significant difference between student teachers' values in mathematics education regarding gender and year spent in the program. In Turkey, the student teachers, who are in their third year of the program, are required to take mathematics education method courses and school experience course (i.e., field observation). When they are in fourth year of the program, student teachers attend field experience course for two semesters. Findings of the current study suggested that the student teachers' values in mathematics education did not change prior to or after taking field experience courses. Along with the studies of Dede (2009, 2014), this study showed that female and male student teachers held similar values in mathematics education. This finding can be interpreted as both male and female students have had similar experiences regarding learning and teaching of mathematics. However, this study showed that there was a significant difference between female and male student teachers

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regarding theory emphasis mathematics teaching. This finding suggested that female student teachers put more emphasis on teaching logical aspects of mathematics in relation to daily life in comparison to male student teachers. As a teacher educator, we should recognize and be aware of the values held by student teachers in learning and teaching of mathematics. As Chin (2006) suggested students perceive mathematical values implicitly through classroom instruction. In addition, positive or negative values perceived by students should be acknowledged or controlled since it plays an important role in the students' future careers (Hill, 1991; Rhodes & Roux, 2004). Bishop (1991a, 1991b) posited that values are being taught to students unconsciously, implicitly and uncritically. In other words, what teachers valued in mathematics was established long before they entered the classrooms. Therefore, it would be essential to determine the student teachers' values related to mathematics education before they become an elementary teacher. Teacher educators should put more effort into developing values-related activities that would guide student teachers to use, adapt or modify values in relation to the teaching and learning of specific mathematics contents (Chin & Lin, 2001). This way, teacher educators would have an opportunity to identify and improve what is being valued in mathematics classrooms by student teachers, since being aware of their values in mathematics teaching can be seen as a crucial element for empowering instruction of teachers (Chin & Lin, 2001).

The current study fills a necessary gap by identifying the importance of research on the student teachers' values regarding mathematics teaching. However, the findings from this study suggested that the further research should focus on identifying implicit and explicit mathematical values in teaching. This way, research should clarify whether or not explicit values are more effective than implicit values in teaching in terms of promoting appropriate values. Understanding of the student teachers' intended and implemented values would allow them to access to their own values regarding mathematics teaching.

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