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Research Article

Analysis of the relationship between mathematics teacher candidates' reflective thinking levels and their philosophical views on the nature of mathematics

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Abstract

The main aim of the present study with relational screening model was to analyze the relationship between reflective thinking skills and philosophical views regarding the nature of mathematics (NoM) in secondary school mathematics teacher candidates. In addition, it was aimed to determine whether the reflective thinking levels of the candidates displayed a significant difference according to absolutist, mixed, and semi-experimentalist groups. The study group consisted of 196 secondary school mathematics teacher candidates studying in the mathematics teaching program in the spring semester of the 2021-2022 academic year. As data collection tools, The Scale for Determining Philosophical Views Regarding the NoM and The Scale for Determining the Level of Reflective Thinking were used. In the analysis of the data, in addition to descriptive statistics, Pearson Product-Moment Correlation Coefficient and multiple linear regression analysis were employed. In the study, it was determined that both reflective thinking levels and the philosophical views regarding the NoM were found to be high in mathematics teacher candidates. Besides, it was determined that there was a positive and moderate relationship between the reflective thinking level subdimensions and and the philosphocial views on the NoM in the teacher candidates, and that the variables of the reflective thinking level subdimensions explained 44% of the variance in the philosophical views on the NoM. Moreover, it was concluded that there was a statistically significant difference between the semi-experimentalist group and the mixed and absolutist groups in favor of the semi-experimentalist group in terms of critical reflection, reflection and understanding skills, and between the absolutist group and the mixed and semi-experimentalist groups in favor of the absolutist group in terms of habitual actions subdimension.

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Introduction

The reflective thinking approach is based on the objectives of the pragmatic philosophy movement led by John Dewey (1933). Dewey dealt with reflective thinking as an active process that requires attention and interpreted reflection as reorganization of the current experience. On the other hand, Mezirow (1991) stated that reflective thinking is a critical evaluation process and classified this situation in four dimensions as habitual actions, understanding, reflection, and critical reflection. Habit, which is accepted as one of the keystones of reflective thinking, consists of actions that

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individuals start to perform without much conscience and thinking as a result of repetitions (riding a bicycle, using the keypad, play on phone, dancing, etc.) Understanding is the individual's accepting an existing situation as it is. Reflection, is the individual's making a meaning for himself/herself and gaining a new perspective at the end of the process. Finally, critical projection is the state of being aware of why individuals perceive, reason, internalize and behave in a certain order (trans: Kember et al., 2000). To Mezirow, individuals with reflective thinking skill can make decisions related to the solution of their problems, implement them, and produce new ideas by evaluating the results. In reflective thinking, it is important for the individual to evaluate and criticize himself/herself (Arslan, 2017; Bozan, 2021). One of the strengths of reflective thinking is that it helps individuals to learn and improve their understanding while realizing teaching activities. In applications performed for reflective thinking skill, students are expected to predict, explore basic facts, and verify their skills to solve mathematics questions. Reflective thinking skills help individuals take responsibility for their learning, define their goals, organize their knowledge, establish a link between theory and knowledge, acquire new knowledge, take more action, and perform their learning processes efficiently (Cengiz & Karatas, 2016). Furthermore, it enables teachers to understand what their students experience in teaching and understanding math by providing support to teachers in coping with the problems they encounter in teaching practices (Toker, 2016). For this reason, it is very valuable that not only teachers but also teacher candidates have this skill and reflect it in the learning environment in order for students to think reflectively.

Ersözlü (2008) interpreted reflective thinking as the individual's self-monitoring, evaluation and recognizing negative behaviors and improving them. If we look at the reflections of reflective thinking in education, it is seen that teachers and students constantly observe themselves, question, evaluate and make self-criticism (Maviş, 2014). Reflective thinking skills of mathematics teachers are accepted as a prerequisite for the realization of the objectives in mathematics education, producing solutions for the problems encountered in the learning environment, and evaluating the experiences gained (Nian, 2020). Therefore, teachers always need to reflect on their teaching applications. The effectiveness of a teacher in the classroom is closely associated with the reflective thinking skills of that teacher on his/her teaching activities (Maksimović & Osmanović, 2019). Especially, the fact that today's mathematics education aims to bring up individuals who have high-level skills such as producing solutions for the problems encountered, and expressing reasoning in this process, making predictions, making evidence-based inferences, and managing one's own feeling and teaching indicators brings important responsibilities to the teachers as well (Ministry of National Education [MoNE], 2018). For these reasons, it is important that teachers should improve their students' reflective thinking skills and encourage them in this regard. However, realizing reflective thinking in students' behaviors is closely related to students' having these characteristics. In this context, reflective thinking should be considered as a necessary part of teacher training and teaching curricula, and awareness of teachers should be increased (Aldahmash et al., 2021; Keskinkılıç-Yumuşak, 2015; Yıldırım, 2012). Findings obtained in studies conducted in the literature emphasize equipping teachers with these competences and frequently indicate the importance of bringing up individuals who have reflective thinking skills (Lee, 2005; Mullis et al., 2012). Hence, it is considered important for teachers to have positive attitudes, perspectives, opinions, thoughts, feelings, and beliefs about the nature of mathematics (NoM), along with high-level thinking skills (Gess-Newsome, 2015).

Beliefs about NoM, involves responses obtained to the questions such as what mathematical knowledge is and how it is acquired. With another aspect, these beliefs are composed of interpretations related to the structure of mathematical knowledge, the existence of mathematical entities, and why mathematics exists (Durmaz, 2016). In this context, philosophical views regarding the NoM are divided into two as absolutists and semi-experimentalists (Baki, 2014: Lee, 2005; Tatto et al., 2008). Those included in the first group think that knowledge has a structure that is absolute, accurate, and consists of unrelated individual parts (Sanalan et al., 2013). The other group believes it was created by the individual through reason or based on empirical evidence (Deryakulu, 2002). According to the absolutists, mathematical knowledge involves certainty, and therefore, it cannot be considered wrong and cannot be changed (Baki, 2014). Besides, it is accepted that the ability to learn is an innate and unchangeable skill, and that an individual will learn a subject either immediately or never (Deryakulu, 2002). On the other hand, according to the semi-experimentalists, mathematical

knowledge is a product of humans and therefore its truth is not absolute, it can be accepted as wrong, and it can be corrected (Baki, 2014). In other words, mathematical knowledge is always open to development and change (Deng, 1995). At the same time, it is argued that mathematical knowledge has a complex structure that is composed of many interrelated parts, and that it is formed by individuals based on reasoning or experimental evidence (Deryakulu, 2002). As a result of these two contradictory views, the ideas that mathematics is an abstract and intellectual pursuit independent of other sciences and that it is an entity used for the benefit of other sciences have developed (Aghadiuno, 1992).

When the effect of views regarding the NoM on teachers' practices are examined, it is seen that the majority of factors such as the teacher's role in the classroom, teaching practices, the methods, strategies and techniques used are affected by the perspectives of the teachers regarding the NoM. It is well-documented that especially the teacher candidates with an absolutist view prefer to directly transfer the knowledge in their classes (Ernest, 1989). Teachers with this perspective additionally believe that it would be enough for students to know certain rules (Işıksal et al., 2007). On the other hand, it has been found in many studies conducted that teacher candidates with semi-experimentalist view design a learning environment for their students in which they can engage in mathematics, and that the environments designed increase students' achievement (Baki, 2014; Baş et al., 2015; Handal, 2003; Lee, 2005). Accordingly, developing the beliefs of teacher candidates regarding the NoM and raising their awareness in this regard will significantly contribute to increasing the quality of learning environments. In fact, it has been emphasized in the mathematics teaching program that students need to question mathematical concepts in the exploration process and internalize the concepts by understanding them, and that learning environments should be designed in line with the interests and needs of the students (MoNE, 2018). In this respect, teachers are expected to use teaching methods and strategies appropriate for the NoM. Especially in recent years, the number of studies on both the teacher candidates' views on the NoM and their reflective thinking skills have increased (Agustan et al., 2016; Akman, 2019; Aydın & Çelik, 2017; Korumaz & Özkılıç, 2015; Sanalan et al., 2013; Soodmand & Farahani, 2018; Thahir et al., 2019; Thomas & Kallarackal, 2020; Viholainen et al., 2014). When these studies were examined, it was noteworthy that the topics of the NoM and reflective thinking/views were generally handled separately, and no study was encountered in which the relationship between these two topics was investigated. Hence, instead of considering the mathematics teacher candidates' levels of reflective thinking and their views on the NoM as two independent variables, it is important to determine the relationship between them and to do practices accordingly. In this respect, it was aimed in the present study to identify the relationship between mathematics teacher candidates' levels of reflective thinking and their philosophical views on the NoM. The subproblems identified within the scope of the research are as follows:

- What are the secondary school mathematics teacher candidates' philosophical views on the NoM and their levels of reflective thinking?
- Is there a significant relationship between the subdimensions of the secondary school mathematics teacher candidates' philosophical views on the NoM and the subdimensions of their level of reflective thinking?
- Do the total mean scores of the secondary school mathematics teacher candidates' views on the NoM display significant correlations with the subdimensions of their reflective thinking levels?
- Do the subdimensions of the secondary school teacher candidates' levels of reflective thinking significantly predict their philosophical views on the NoM?
- Do the subdimensions of the secondary school teacher candidates' levels of reflective thinking display a significant difference with respect to the absolutists, mixed, and semi-experimentalist groups?

Method

Research Model

The relational survey model was used in the research in which the relationship between philosophical thinking about the NoM and reflective thinking was examined. The relational survey model is a research model that helps to understand the direction or degree of change between two or more variables (Karasar, 2022). With this model, it is tried to obtain

information about the direction and level of the relationship. In the descriptive research, the amount of change between two or more variables was tried to be determined under current conditions. In this direction, reflective thinking and its subdimensions of critical reflection, reflection, understanding and habit were considered as independent variables.

Study Group

The study group consists of 196 volunteer teacher candidates teaching in the mathematics education program of three different state universities in the spring term of the 2021-2022 academic year. Of the teacher candidates, 148 (75.5%) are females and 48 (24.5%) males. While forming the study group, attention was paid to the convenience of sampling and for this, non-random sampling type was preferred. In this methodology, which is used to avoid time, cost and labor loss, an understanding that includes accessible and applicable units is dominated (Büyüköztürk et al., 2014). In this respect, an economical and easily accessible process was taken into account in the creation of the determined sample. Among other reasons for the selection of the study group in this way, the presence of students who want to take part in the research voluntarily and the limitations of the application time can be cited.

Data Collection Tools

The Scale for Determining the Philosophical Thoughts on the NoM developed by Sanalan et al., (2013) was used to determine the philosophical thoughts of the pre-service teachers about the NoM. The scale consists of 25 items and four dimensions. The scale contains a total of 25 items and consists of four subdimensions. These dimensions of the 5-point Likert-type scale is daily life (DL), problem-solving (PS), the structure of mathematics (MS) and mathematical thinking (MT), respectively. There are 8 items in the DL dimension, 6 items in the PS dimension, 7 items in the MT dimension and 4 items in the MS dimension. Confirmatory factor analysis was performed to test the construct validity of the scale, and it was determined that the four-factor structure of the scale was compatible with the data set. Four factors explained 42.7% of the total variance. In addition, the total Cronbach Alpha internal consistency coefficient of the scale was tested and calculated as .85. The Cronbach Alpha reliability coefficients of the scale factors are respectively; DF .81; PS .65; MT was determined as .63 and the MS was determined as .70. Within the scope of this study, the total Cronbach's alpha internal consistency coefficient of the scale was calculated and found to be .88. According to the scores obtained from the scale, the groups and score ranges are between 25-75 points in the absolutist group, between 76-94 points in the mixed group and between 95-125 points in the semi-experimentalist group. In determining the group score ranges, the "z" scores were determined by calculating, since the data met the normality condition, and cut-off points were created accordingly. Accordingly, it can be evaluated that individuals with a z value less than -1.3 have an absolutist point of view, those with a z value between -1.3 and 0.2 have a mixed perspective, and those with a value of 0.2 and higher have a semi-empirical point of view. On the other hand, Kember et al. (2000) and adapted into Turkish by Başol and Evin-Gencel (2013), the Scale for Determining the Level of Reflective Thinking was used. The scale consists of a total of 16 items and four dimensions. The subdimensions of the 5-point Likert-type scale is critical reflection, reflection, habitual actions and understanding respectively. Each dimension has an equal number of items. Confirmatory factor analysis was performed to test the construct validity of the scale, and it was determined that the four-factor structure of the scale was compatible with the data set ($\chi 2/df=4.48$; RMSEA=.07; GFI=.93; AGFI=.90; NNFI=.92; CFI=.93). Four factors explained 53% of the total variance. In addition, the total Cronbach's Alpha internal consistency coefficient of the scale was tested and calculated as .77. The Cronbach Alpha reliability coefficients of the scale factors are respectively; critical reflection .68, reflection .72, understanding .69 and habitual actions .54. Within the scope of this research, the total Cronbach Alpha internal consistency coefficient of the scale was calculated and calculated as .78. After obtaining the necessary permissions regarding the measurement tools, it was applied by the researcher on a voluntary basis in accordance with the purpose of the study. The application of the scales was carried out in the digital environment, and the Google Forms application was used for this. The application time of each scale takes approximately 8-10 minutes.

Analysis of Data

In this study, arithmetic means and standard deviation values were taken into account in determining the philosophical thoughts and reflective thinking levels of prospective teachers about the NoM. The determined values were interpreted as very low between 1-1.79, low between 1.80-2.59, medium between 2.60-3.39, high between 3.40-4.19 and very high

between 4.20-5.00. Pearson Product Moments Correlation Coefficients technique was used to determine the relationship between philosophical thoughts about the NoM and reflective thinking levels. These coefficients were interpreted as low between .00-.29, medium between .30-.69 and high level between .70-1.00 (Büyüköztürk, 2019). In another step, effect of reflective thinking level on philosophical thoughts about the NoM was examined by multiple regression analysis. Before this regression analysis, there are a number of actions that need to be taken to satisfy the assumptions required. These procedures must be performed. In this context, it is recommended to examine the effects of extreme values, the agreement between the assumptions and the problem of multicollinearity (Çokluk et al., 2014). In the normality analysis performed before the difference analysis, it was determined that the skewness values ranged between -.78 and .32, and the kurtosis values ranged between -.48 and .65. In order for the assumption of normality to be met, the skewness and kurtosis values should be in the range of ± 1 (Büyüköztürk, 2019). Accordingly, it can be said that the data meet the normality assumption. In another step, the linear relationship between the variables was tested. In order to test the linear relationship between the variables, the scatter diagram was examined and it was determined that the variables extend to the right and are in a linear relationship. Another assumption of multiple regression analysis is to determine whether there is a multi-collinearity problem among the predictive variables. The multi-collinearity problem arises when there are strong relationships (r>.90 and above) among the independent variables (Çokluk et al., 2014). In order to test the multicollinearity problem, correlations between variance increase factors (VIF), tolerance values (TV), state index (CI) and independent variables are examined (Çokluk et al., 2014). Accordingly, if VIF values are greater than or equal to 10 (VIF≥10), TV values are less than or equal to .10 (TV≤.10), and CI values are greater than or equal to 30 (CI≥30) multicorrelation It means it has a problem (Çokluk et al., 2014). In this study, the highest correlation value between independent variables was .62. The VIF values of the variables are 1.02-1.56; CI values vary between 1.00-23.08 and TV values between .63-.97. According to these results, VIF, CI and TV values show that there is no multicollinearity problem between the independent variables. As a result, regression analysis was performed with 196 data sets in line with the findings. Finally, ANOVA test was applied to understand whether the reflective thinking levels of pre-service mathematics teachers differ significantly between absolutist, mixed and quasi-experimental groups. Since the variances were homogeneous, Hochberg's GT2 test, one of the post hoc multiple comparison tests, was used.

Findings

In this part of the study, the findings obtained within the scope of the study have been presented. In this context, firstly, descriptive analyses regarding the mathematics teacher candidates' philosophical views on the NoM and their levels of reflective thinking have been provided. Then, the relationships between the subdimensions of the philosophical views on the NoM and the subdimensions of reflective thinking, the relationships between the total mean score of the philosophical views on the NoM and the subdimensions of reflective thinking, and multiple regression analysis and ANOVA results that indicate the difference of the subdimensions of reflective thinking with respect to the absolutist, mixed, and semi-experimentalist groups have been presented. Accordingly, descriptive statistical findings involving the philosophical views on the NoM and reflective thinking skills are shown below:

Table 1. *Descriptive Statistics Regarding the Subdimensions of Assessment Tools*

Scales	Subdimensions	$\bar{X}$	Sd.	Skewness	Kurtosis	Total
Philosophical Views on the NoM	Daily Life	4.02	.57	-.41	.19	789.75
	Problem Solving	4.03	.53	-.14	-.48	790.50
	Mathematical Thinking	3.91	.54	-.41	.31	766.71
	Mathematics' Structure	4.03	.58	-.78	.32	790.00
Determining the Level of Reflective Thinking	Critical Reflection	3.50	.75	-.06	-.12	686.75
	Reflection	3.79	.64	-.15	-.05	743.25
	Understanding	3.77	.56	.02	-.18	739.25
	Habitual Actions	2.96	.63	-.19	.13	582.00

When Table 1 was examined, it was seen that among the philosophical views of the mathematics teacher candidates on the NoM, their views on DL ($\bar{X}$=4.02), PS ($\bar{X}$=4.03), MT ($\bar{X}$=3.91), and the MS ($\bar{X}$=4.03) were at a high level. On

the other hand, among the reflective thinking skills of the mathematics teacher candidates, it was determined that critical reflection ($\bar{X}$=3.50), reflection ($\bar{X}$=3.79), and understanding levels ($\bar{X}$=3.77) were at a high level, while habitual action levels ($\bar{X}$=2.96) were at a moderate level. When the total mean scores of the scales were considered, the teacher candidates' both philosophical view on the NoM ($\bar{X}$=3.99) and reflective thinking levels ($\bar{X}$=3.50) were at a high level. The findings regarding the relationship between the philosophical views on the NoM and the subdimensions of reflective thinking levels are presented below:

Table 2. *Relationship Values Between the Subdimensions of the Assessment Tools*

Variables		DL	PS	MT	MS	CR	RF	UN	HA
DL	r	1	.57**	.42**	.33**	.52**	.64**	.38**	-.07
	p	.	.00	.00	.00	.00	.00	.00	.31
PS	r		1	.60**	.46**	.40**	.63**	.27**	-.23**
	p		.	.00	.00	.00	.00	.00	.00
MT	r			1	.61**	.15*	.35**	.24**	-.29**
	p			.	.00	.03	.00	.00	.00
MS	r				1	.09	.23**	.11	-.27**
	p				.	.20	.00	.11	.00
CR	r					1	.51**	.33**	-.12
	p					.	.00	.00	.07
RF	r						1	.46**	-.09
	p						.	.00	.18
UN	r							1	.01
	p							.	.86
HA	r								1
	p								.

Note: DL: Daily Life, PS: Problem Solving, MT: Mathematical Thinking, MS: Mathematics' Structure, CR: Critical Reflection, RF: Reflection, UN: Understanding, HA: Habitual Actions **p<.01, *p<.05

When Table 2 was examined, it was observed that there were both positive and negative significant relationships between the philosophical views on the NoM and the subdimensions of reflective thinking. Accordingly, positive and significant relationships were found between DL and critical reflection (r=.52, p<.01), reflection (r=.64, p<.01), and understanding (r=.38, p<.01). Also, a positive and significant relationship was determined between PS and critical reflection (r=.40, p<.01), reflection (r=.63, p<.01), and understanding (r=.27, p<.01), and a negative relationship with habitual actions (r=-.23, p<.01). Finally, a positive and significant relationship was determined between MT and reflection (r=.23, p<.01), and a negative and significant relationship of MT with habitual actions (r=-.27, p<.01) was found. The findings obtained regarding the relationship between the mathematics teacher candidates total mean score on the philosophical views on the NoM and the subdimensions of reflective thinking levels are presented below:

Table 3. *The Relationship Between Total Mean Score on Philosophical Views on the NoM and the Subdimensions of Reflective Thinking*

Variables		NoM Total	CR	RF	UN	HA
NoM Total	r	1	.41**	.63**	.35**	-.26**
	p	.	.00	.00	.00	.00
CR	r		1	.51**	.33**	-.12
	p		.	.00	.00	.07
RF	r			1	.46**	-.09
	p			.	.00	.18
UN	r				1	.01
	p				.	.86
HA	r					1
	p					.

NoM: Nature of Mathematics, **p<.01

When Table 3 was analyzed, it was seen that there were positive and negative significant relationships between the total score on the philosophical views on the NoM and the subdimensions of reflective thinking levels. Accordingly, a positive and moderate relationship was found between the philosophical views on the NoM and critical reflection (r=.41, p<.01), reflection (r=.63, p<.01), and understanding (r=.35, p<.01), while a negative and low-level relationship was found with habitual actions (r=-.26, p<.01). The findings regarding whether the secondary school mathematics teacher candidates' reflective thinking skill levels predicted the philosophical views on the NoM, which is one of the subproblems of the study, are presented below:

Table 4. *Multiple Regression Analysis Results Between the Philosophical Views on the NoM and the Subdimensions of Reflective Thinking Levels*

Variables	*B*	S.E.	Std. β	t	*p*	F	R	R^2
Constant	2.63	.21	-	12.11*	.00	37.98	.66	.44
CR	.04	.03	.08	1.31	.19			
RF	.36	.04	.52	7.82*	.00			
UN	.05	.04	.07	1.22	.22			
HA	-.13	.03	-.20	-3.66*	.00			

**p<.01

When Table 4 was examined, it was seen that the variables regarding the subdimensions of critical thinking levels explained 44% of the variance in the philosophical views on the NoM (R^2=.44). It was also observed that the effect of the variables of reflection (t=7.82, p<.01) and habitual actions (t=-3.66, p<.01) on the philosophical views on the NoM was statistically significant. Accordingly, it was determined that with all other variables being constant, a one unit increase in the reflection dimension led to an increase of .36 unit in the philosophical views on the NoM, and that a one unit increase in the habitual actions dimension led to a decrease of .13 unit in habitual actions. It was also found that critical reflection (t=1.31, p>.05) and understanding (t=1.22, p>.05) subdimensions did not statistically predict the effect on the philosophical views on the NoM. The findings related to whether the subdimensions of the secondary school mathematics teacher candidates' reflective thinking levels differed according to the absolutist, mixed, and semi-experimentalist groups, which is another subproblem of the study, are presented below:

Table 5. *ANOVA Results of the Subdimensions of Reflective Thinking Levels According to Absolutist, Mixed, and Semi-experimentalist Groups*

Dimension	Groups	N	$\bar{X}$	Std.	Source of Variance	Sum of Squares	df	Mean Square	F	Differ
CR	Absolutist	23	3.13	.65	Between Groups	11.68	2	5.84	11.31*	3>1
	Mixed	98	3.36	.68	Within Groups	99.63	193	.51		3>2
	Semi-experimentalist	75	3.80	.77	Total	111.31	195			
RF	Absolutist	23	3.14	.58	Between Groups	28.01	2	14.00	52.02*	2>1
	Mixed	98	3.60	.50	Within Groups	51.95	193	.26		3>1
	Semi-experimentalist	75	4.23	.51	Total	79.96	195			3>2
UN	Absolutist	23	3.40	.55	Between Groups	6.50	2	3.25	11.04*	2>1
	Mixed	98	3.70	.52	Within Groups	56.84	193	.29		3>1
	Semi-experimentalist	75	3.97	.56	Total	63.34	195			3>2
HA	Absolutist	23	3.33	.53	Between Groups	4.24	2	2.12	5.46*	1>2
	Mixed	98	2.97	.60	Within Groups	74.94	193	.38		1>3
	Semi-experimentalist	75	2.84	.66	Total	79.18	195			

*p<.05

When Table 5 was analyzed, it was seen that 50% (*n*=98) of the mathematics teacher candidates had a mixed view of the NoM, 38.3% (*n*=75) had a semi-experimental perspective, and 11.7% (*n*=23) had an absolutist view. In addition, in terms of the subdimension of reflective thinking levels, a significant difference was found between the semi-experimentalist group and absolutist group in favor of the semi-experimentalist group ($F_{(2-193)}$=11.31, p<.05). In the subdimension of reflective thinking levels, significant differences were found between the mixed group and absolutist

group in favor of the mixed group, between the semi-experimentalist group and absolutist group in favor of the semi-experimentalist group, and between the semi-experimentalist group and mixed group in favor of the semi-experimentalist group ($F_{(2-193)}$=52.02, p<.05). In the subdimension of understanding, significant differences were determined between the mixed group and absolutist group in favor of the mixed group, between the semi-experimentalist group and absolutist group in favor of the semi-experimentalist group, and between the semi-experimentalist group and mixed group in favor of the semi-experimentalist group ($F_{(2-193)}$=11.04, p<.05). In the habitual actions subdimension, a significant difference was found between the absolutist group and the mixed and semi-experimentalist groups in favor of the absolutist group ($F_{(2-193)}$=5.46, p<.05).

Discussion and Conclusion

As a result of the study, it was determined that mathematics teacher candidates' philosophical views on the NoM were at a high level. It was also determined that the teacher candidates' views regarding all subdimensions such as DL, PS, MT, and the MS were at a high level. It is believed that this result obtained is positive in terms of the efficacy and applicability of teacher training programs. This is because it was determined in studies conducted that teachers' beliefs regarding the NoM guided their educational activities (Aktamış, 2012; Baydar & Bulut, 2002; Chrysostomoua & Philippou, 2010; Prediger, 2007). Hence, based on the finding obtained, it can be claimed that the mathematics teacher candidates will conduct their educational activities in line with structuralist approach rather than behaviorist approach. Similarly, in a study conducted, it was determined that teacher candidates had a student-centered approach regarding both the NoM and mathematics teaching (Dede & Uysal, 2012). In yet another study, it was found that teacher candidates' traditional views on the NoM were at a moderate level, while their non-traditional beliefs in this regard were at a high level (Duru & Göl, 2016).

Another result obtained in the present study was that 50% of the participating mathematics teacher candidates had a mixed view of the NoM, 38.3% a semi-experimentalist perspective, and 11.7% an absolutist point of view. Hence, the low percentage of mathematics teacher candidates in the absolutist group, who believe that mathematics only consists of a series of rules and operations, can be interpreted as a pleasing result. However, the fact that 50% of the teacher candidates were in the mixed group shows that they adopted the semi-experimentalist view in some cases and the absolutist perspective in some other cases. Therefore, it can be stated that the views of these mathematics teacher candidates regarding the NoM have not clarified yet, and that they are confused in this regard. In another study conducted, differently from the result obtained in the present study, it was determined that 49% of the teacher candidates adopted the semi-experimentalist view, 14% had the absolutist view, and 37% adopted both perspectives (Sanalan et al., 2013). The difference between the results is thought to have stemmed from the differences in the period when the studies were conducted and the study samples selected. While only mathematics teacher candidates were included in the sample of the present study, in the sample of the study conducted by Sanalan et al. (2013), science, mathematics, classroom, and social sciences teacher candidates were included. Besides, as the present study was conducted following the distance learning process in the pandemic period, it is thought that distance education affected the result.

Another result obtained in the present study was that the mathematics teacher candidates' reflective thinking levels were high. Similarly, in studies previously conducted, it was determined that teacher candidates (Duban & Yanpar-Yelken, 2010; Gözel & Toptaş, 2017; Keskinkılıç-Yumuşak, 2015) and teachers (Atılkan-Tuncer & Sapancı, 2021; Fırat-Durdukoca & Demir, 2012) had high levels of reflective thinking inclination. However, there are also studies which found the teacher candidates' reflective thinking levels as moderate (Erdogan & Şengül, 2014) or low (Rodgers, 2002). In addition, as a result of the present study, it was determined that the reflective thinking levels of mathematics teacher candidates were high in the subdimensions of critical reflection, reflection, and understanding. Based on this finding, it can be claimed that the mathematics teacher candidates had reflective thinking skills; in other words, they could question their past and current experiences, guide their future activities by inferring from their experiences, and produce new ideas. On the other hand, the mathematics teacher candidates' levels in the subdimension of habitual actions were found

to be at a moderate level. This may have resulted from their having received education in their previous life based on repetition and reinforcement. It is thought that as they were made to solve similar problems repetitively, the teacher candidates responded to these examples without thinking and therefore they formed a habit.

When the relationships between the philosophical views on the NoM and the subdimensions of reflective thinking were examined, it was determined that there were positive relationships between the subdimensions of DF, PS, and MT and the subdimensions of critical reflection, reflection, and understanding. When the literature was reviewed, it was seen that reflective thinking was reported to be associated with PS steps. Reflective thinking has been defined as analyzing the knowledge and restructuring it as well as the process of establishing and solving the problem. In addition, the purpose of reflective thinking has been expressed as understanding a situation or a problem and solving it in a better way (Schon, 1987). Also, it has been determined that reflective thinking skill is a significant predictor of PS success (Kızılkaya, 2009). Individuals are expected to reflect the experiences they have gained in the PS process onto the DF as well. Finally, it was determined in the present study that the subdimension of habitual actions was negatively correlated with the dimensions of PS, MT, and the MS. Habitual actions have been defined as actions that are started to be performed unconsciously and without thinking as a result of repetitions (Mezirow, 1991). Therefore, this result obtained in the dimension of habitual actions can be said to be an expected result, as thinking and questioning were not performed.

In the present study, it was concluded that there was a positive and moderate relationship between the subdimensions of the mathematics teacher candidates' reflective thinking levels and their philosophical views on the NoM. Besides, it was determined that the variables related to the subdimensions of the mathematics teacher candidates reflective thinking levels explained 44% of the variance in their philosophical views on the NoM. Accordingly, it can be stated that as the levels of the mathematics teacher candidates' reflective thinking increase, the levels of their philosophical views on the NoM will also increase. Considering the subdimensions, it was determined that the subdimensions of reflection and habitual actions statistically significantly predicted the mathematics teacher candidates' philosophical views on the NoM. In fact, it was observed that a one unit increase in the reflection subdimension led to an increase of .36 unit in philosophical views on the NoM, and that a one unit increase in the subdimension of habitual actions caused a decrease of .13 unit in the philosophical views on the NoM. Hence, based on this, it can be inferred that in order to improve individuals' philosophical views on the NoM, it is necessary to provide education that involves questioning and discussing rather than a training based on memorization and habits. On the other hand, as a result of the study, it was determined that the subdimensions of critical reflection and understanding did not statistically significantly predict the teacher candidates' philosophical views on the NoM. It has been stated that since a change should be experienced in the individual's perspective, especially at the level of critical reflection, this is very unlikely and not experienced much (Kember et al., 2000). This feature of critical reflection level can be considered the reason for this result. In addition, it has been stated that the subdimension of understanding in the scale used in the present study is limited to the comprehension step in Bloom's classification of cognitive domain learning (Başol & Evin-Gencel, 2013). Therefore, it can be claimed that education provided at the level of comprehension is not enough to improve individuals' philosophical views on the NoM. In order to improve this view, it is believed that studies aimed at analysis, synthesis, and evaluation steps should be conducted.

Finally, as a result of the study, it was determined that there was a statistically significant difference between the semi-experimentalist group and the mixed and absolutist groups in favor of the semi-experimentalist group in terms of the secondary school mathematics teacher candidates' critical reflection, reflection, and understanding skills. Moreover, regarding the secondary school mathematics teacher candidates' reflection and understanding skills, a statistically significant difference was found between the mixed group and the absolutist group in favor of the mixed group. Accordingly, it can be claimed that the critical reflection, reflection, and understanding skills of the mathematics teacher candidates in the semi-experimentalist group are at a higher level. Literature review revealed that semi-experimentalists argue that mathematical knowledge is an endeavor of human product that is falsifiable, applicable, and is fed on practical experiences, develops, and changes (Baki, 2008; Handal, 2003). In addition, as a result of the study, it was concluded that regarding the subdimension of habitual actions of the mathematics teacher candidates, a statistically significant

difference between the absolutist group and the mixed and semi-experimentalist groups was determined in favor of the absolutist group. Similarly, it has been stated that in the absolutist perspective, mathematics consists of a series of rules that need to be memorized and arithmetic calculations (Steinbring 1998; Van de Walle, 2004). Furthermore, it has been indicated that the absolutists argue that mathematical knowledge is composed of definite and unchanging truths, and that mathematical truths that are transferred can be learned through memorization by repetition (Baki, 2008; Işıksal, 2007). Hence, it can be claimed that as the subdimension of habitual actions is defined as actions that are performed without thinking as a result of repetitions, it is compatible with the absolutist view.

Recommendations

In line with the results obtained in the study, it was seen that the mathematics teacher candidates had the absolutist view in some cases and the semi-experimentalist perspective in other cases; in other words, they experienced indecision. Hence, it is important to examine in detail in what cases the teacher candidates experience indecision and the reasons for this situation. In addition, in the study, it was determined that the reflective thinking skills of the mathematics teacher candidates improved their philosophical views on the NoM. In this context, it can be recommended that activities that will improve the teacher candidates' reflective thinking skills should be organized. Moreover, in order for the teacher candidates' views on the NoM to develop, discussions on the relationship of mathematics with DF and other disciplines and the structure and importance of MT should be included. It is also believed that it would be effective to do applications related to the changeability of mathematical knowledge, i.e., getting the teacher candidates to question in what situations the theories are verified and under what conditions they are invalid. As a result of the study, it was determined that the mathematics teacher candidates had a high level of reflective thinking and philosophical views on the NoM. However, as the study data were collected through scales based on self-report and self-perception, if it is examined whether the teacher candidates reflected these skills onto their in-class practices through mixed methods that include observation and interview, a contribution can be made to the literature. When the literature was reviewed, no study that examined the relationship between teacher candidates' reflective thinking levels and their philosophical views on the NoM was encountered. Therefore, conducting similar studies with different samples is considered important in terms of comparing the results obtained.

Limitations of the Study

The data of this study is limited to the answers of 196 volunteer teacher candidates teaching in mathematics education programs of three different state universities in the spring semester of the 2021-2022 academic year. Another limitation of the study is that volunteer students were included in the study. Therefore, the opinions of students who did not participate in the study or did not want to participate may differ.

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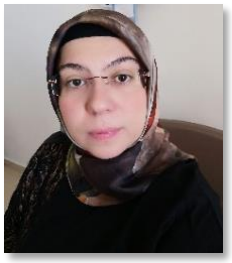
Biodata of Authors



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References

Aghadiuno, M. C. K. (1992). Mathematics: history, philosophy and applications to science. *International Journal of Mathematical Education in Science and Technology, 23*(5), 683-690. https://doi.org/10.1080/0020739920230506

Agustan, S., Juniati, D., & Siswono, T. Y. E. (2017). Reflective thinking in solving an algebra problem: A case study of field independent-prospective teacher. *Journal of Physics: Conference Series, 893*(1), 1-6. https://doi.org/10.1088/1742-6596/893/1/012002

Aktamış, H. (2012). How prospective mathematics teachers view the nature of science. *Procedia-Social and Behavioral Sciences, 31*, 690-694.

Aldahmash, A. H., Alshalhoub, S. A., & Mohammed, M. A. (2021). Mathematics teachers' reflective thinking: Level of understanding and implementation in their professional practices. *PLoS ONE 16*(10), 1-17. https://doi.org/10.1371/journal.pone.0258149

Arslan, M. M. (2017). Candidates' awareness of teaching practice in their reflective diaries. *Bartın University Journal of the Faculty of Education, 6*(3), 1017-1026. https://doi.org/10.14686/buefad.311276

Atılkan-Tunçer, A., & Sapancı, A. (2021). The relationship between reflective thinking tendencies of secondary school mathematics teachers and the levels of creating constructivist learning environment. *Asian Journal of Instruction, 9*(2), 75-96.

Aydın, S., & Çelik, D. (2017). Adaptation of the scale of beliefs about the nature of mathematics to Turkish culture. *Theory and Practice in Education*, *13*(4), 715-733.

Baki, A. (2014). *Matematik tarihi ve felsefesi [History and philosophy of mathematics].* Ankara: Pegem Academy.

Baki, A. (2008). K*uramdan uygulamaya matematik eğitimi [Mathematics from theory to practice]*. Ankara: Harf Education Publishing.

Baş, F., Işık, A. Çakmak, Z., Okur, M., & Bekdemir, M. (2015). Primary education mathematics teacher candidates' thoughts on the nature of mathematics: A structural equation model analysis. *Kastamonu Journal of Education, 23*(1), 123-140.

Başol, G., & Evin-Gencel, İ. (2013). Reflective thinking scale: A validity and reliability study. *Educational Sciences: Theory & Practice, 13*(2), 941-946.

Baydar, S. C., & Bulut, S. (2002). Importance of teachers' beliefs about nature of mathematics and teaching of mathematics in mathematics education. *Hacettepe University Journal of Education, 23*, 62-66.

Bozan, S. (2021). Determining students' reflective thinking levels and examining their reflections on science concepts. *African Educational Research Journal*, *9*(2), 544-550. https://doi.org/10.30918/AERJ.92.21.070

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2014). *Bilimsel araştırma yöntemleri [Scientific research methods]* (17th ed.). Ankara: Pegem Publishing.

Büyüköztürk, Ş. (2019). *Sosyal bilimler için veri analizi el kitabı [Manual of data analysis for social sciences]* (24th ed.). Ankara: Pegem Academy Publishing.

Cengiz, C., & Karataş, F. Ö. (2016). Reflective thinking and teaching. *Journal of National Educ*ation, *45*(211), 5-27.

Chrysostomoua, M., & Philippou, G. N. (2010). Teachers' epistemological beliefs and efficacy beliefs about Mathematics. *Procedia Social and Behavioral Sciences, 9*, 1509-1515.

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2014). *Sosyal bilimler için çok değişkenli istatistik: SPSS ve LISREL uygulamaları [Multivariate statistics for social sciences: SPSS and LISREL applications]* (3th ed.). Ankara: Pegem Academy Publishing.

Dede, Y., & Uysal, F. (2012). Examining Turkish pre-service elementary teachers' beliefs about the nature and the teaching of mathematics. *International Journal of Humanities and Social Science, 2*(12), 125-135.

Deng, Z. (1995). Estimating the reliability of the teacher questionnaire used in the Teacher Education and Learning to Teach (TELT). *National Center for Research on Teacher Learning Technical Series, 95*(1), 1-37.

Deryakulu, D. (2002). The relationship of locus of control and epistemological beliefs and instructional material comprehension monitoring types and levels. *Hacettepe University Faculty of Education Journal, 22,* 55-61.

Dewey, J. (1933). *How we think: A Restatement of the relation of reflective thinking to the educative process.* Boston: Heath & Co Publishers.

Duban, N., & Yanpar-Yelken, T. (2010). Pre-service teachers' reflective thinking tendencies and views on reflective teacher characteristics. *Journal of the Cukurova University Institute of Social Sciences, 19*(2), 343-360.

Durmaz, M. (2016). *Philosophical views of primary school mathematics teacher candidates on the nature of mathematics.* 3rd International Eurasian Educational Research Congress (p. 1327-1328). Muğla: Sıtkı Koçman University.

Duru, A., & Göl, R. (2016). Beliefs of prospective teachers about mathematics, mathematics teaching and mathematics learning. *Adıyaman University Journal of Educational Sciences, 6*(2), 255-282.

Erdoğan, F., & Şengül, S. (2014). The investigation of pre-service elementary mathematics teachers' reflective thinking levels. *Asian Journal of Instruction, 2*(1), 18-30.

Ernest, P. (1989). The knowledge, beliefs and attitudes of the mathematics teacher: A model. *Journal of Education for Teaching, 15*(1), 13-33.

Ersözlü, Z. N. (2018). *The effects of reflective thinking activities on the academic successes and attitudes of fifth grade primary social studies students.* (Unpublished doctoral dissertation), Fırat University, Elazığ.

Fırat-Durdukoca, Ş., & Demir, M. (2012). Reflective thinking levels of primary school teachers according to some variables and the relevance of teacher qualities in their mind to the qualities of reflective teacher. *Mustafa Kemal University Journal of Social Sciences Institute, 9*(20), 357-374.

Gess-Newsome, J. (2015). A model of teacher professional knowledge and skill including PCK: Results of the thinking from the PCK Summit. In A. Berry, P. Friedrichsen, & J. Loughran (Eds.), *Re-examining pedagogical content knowledge in science education* (pp. 28-42). New York, NY Routledge.

Gözel, E., & Toptaş, V. (2017). The relationship between mathematical teaching efficacy beliefs and reflective thinking skills of pre-service primary school teachers. *Cumhuriyet International Journal of Education, 6*(4), 412-425.

Handal, B. (2003). Teachers' mathematical beliefs: A review. *The Mathematics Educator,13*(2), 47-57.

Işıksal, M., Kurt, G., Doğan, O., & Çakıroğlu, E. (2007). Epistemological conceptions of pre-service elementary mathematics teachers: effects of university and grade level. *Elementary Education Online, 6*(2), 313-321.

Karasar, N. (2022). *Bilimsel araştırma yöntemi [Scientific research method]* (37th ed.). Ankara: Nobel Publishing.

Kember, D., Leung, D., Jones, A., Loke, A., McKay, J., Sinclair, K., et al. (2000). Development of a questionnaire to measure the level of reflective thinking. *Assessment and Evaluation in Higher Education, 25*(4), 381-395. https://doi.org/10.1080/713611442

Keskinkılıç-Yumuşak, G. (2015). Reflective thinking tendencies of preservice teachers and their attitudes towards the teaching profession. *Bartın University Journal of Faculty of Education, 4*(2), 466-481.

Kızılkaya, G. (2009). *The effect of web-based learning environments supported by reflective thinking activities on problem-solving*. (Unpublished doctoral dissertation), Hacettepe University, Ankara.

Korumaz, M., & Özkılıç, R. (2015). Examining the directions for reflection as a foreign language. *Marmara University Atatürk Faculty of Education Journal of Educational Sciences, 42*(42), 299-316.

Kuryel, B. (2009). Bir kültür olarak matematik [Mathematics as a culture]. *Social History,* 34-41. Retrieved from https://silo.tips/download/bir-kltr-olarak-matematik

Lee, H. J. (2005). Understanding and assessing preservice teachers' reflective thinking. *Teaching and Teacher Education, 21*(6), 699-715. https://doi.org/10.1016/j.tate.2005.05.007

Maksimovic, J. Ž., & Osmanovic, J. S. (2019). Teachers' self-concept and its benefits for science education. *Journal of Baltic Science Education*, *18*(1), 105-116. https://doi.org/10.33225/jbse/19.18.105

Maviş, F. Ö. (2014). *Comparison of high school teachers' reflective practice level and their students' reflective thinking skills.* (Unpublished master's thesis), Gaziosmanpaşa University, Tokat.

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco: Jossey-Bass.

Ministry of National Education (MoNE) (2018). *Matematik dersi öğretim programı (İlkokul ve ortaokul 3, 4, 5, 6, 7 ve 8. sınıflar) [Mathematics lesson curriculum (primary and middle school 3, 4, 5, 6, 7 and 8th grades)].* Ankara: MoNE.

Mullis, I. V. S., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Nian, Z. (2020). To promote the development of teachers' teaching beliefs from reflective teaching. *Open Journal of Social Sciences*, *8*(11), 120-126. https://doi.org/10.4236/jss.2020.811012

Prediger, S. (2007). Philosophy of mathematics in teacher training courses, François. In K. & Bendegem, J. P. (Eds.), *Philosophical dimensions in mathematics education,* (p. 43-59). New York: Springer Science Business Media.

Rodgers, C. (2002). Defining reflection: another look at John Dewey and reflective thinking. *Teachers College Record, 104*(4), 842-866.

Sanalan, V. A., Bekdemir, M., Okur, M., Kanbolat, O., Baş, F., & Sağırlı, M. Ö. (2013). Preservice teachers' philosophical thoughts about the nature of mathematics. *Pamukkale University Journal of Education, 33*(1), 155-168.

Schon, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco: Jossey-Bass.

Soodmand A. H., & Farahani, M. (2018). Inhibitors to EFL teachers' reflective teaching and EFL learners' reflective thinking and the role of teaching experience and academic degree in reflection perception. *Reflective Practice, 19*(1), 46–67. https://doi.org/10.1080/14623943.2017.1351353

Steinbring, H. (1998). Elements of epistemological knowledge for mathematics teachers. *Journal of Mathematics Teacher Education, 1*(2), 157-189.

Tatto, M. T., Schwille, J., Senk, S., Ingvarson, L., Peck, R., & Rowley, G. (2008). *Teacher education and development study in Mathematics (TEDS-M): Policy, practice, and readiness to teach primary and secondary mathematics. Conceptual framework.* East Lansing, MI: Teacher Education and Development International Study Center, College of Education, Michigan State University.

Thahir, A., Komarudin, K., Hasanah, U. N., & Rahmahwaty, R. (2019). Murder learning and self efficacy models: impact on mathematical reflective thinking ability. *Journal for the Education of Gifted Young Scientists*, *7*(4), 1123-1135.

Thomas, P. J., & Kallarackal, T. J. (2020). Themes of critical incidents in student teachers' reflective journal writings. *International Journal of Multidisciplinary Educational Research*, *9*(4), 55-62.

Toker, G. Z. (2016). *A preservice mathematics teacher's reflective practices on self-improvement regarding teaching and learning process in practice teaching.* (Unpublished doctoral dissertation), Middle East Technical University, Ankara.

Van de Walle, J. A. (2004). *Elementary and middle school mathematics: Teaching developmentally.* New York: Pearson Education, Inc.

Viholainen, A., Asikainen, M., & Hirvonen, P. E. (2014). Mathematics student teachers' epistemological beliefs about the nature of mathematics and the goals of mathematics teaching and learning in the beginning of their studies. *Eurasia Journal of Mathematics, Science & Technology Education, 10*(2), 159-171. https://doi.org/10.12973/eurasia.2014.1028a

Yıldırım, S. (2012). Teacher support, motivation, learning strategy use, and achievement: A multilevel mediation model. *The Journal of Experimental Education*, *80*(2), 150-172.