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Investigation of Primary Teacher Candidates' Curiosity in Mathematics in Terms of Various Variables

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Abstract
Curiosity is essential to scientific discovery and innovation, and more universally, it is a natural and unavoidable characteristic of children. It is shown as a process in which efforts are made to fill the knowledge gap. It is an important element of learning and it increases math achievement. This research reveals the level of curiosity in candidate primary mathematics teachers and discusses the precautions to be taken through various variables. A descriptive survey model was used in this study. This research was carried out during the 2021-2022 academic year. The study group of the research consists of 262 candidate primary school teachers studying at state universities located in the south of Turkey. In the research, "Mathematical Curiosity Scale for Classroom Teachers and Teacher Candidates" and "Personal Information Form" were used as data collection tools. In the study, primary school teacher candidates' gender, type of the high school they graduated from, positive and negative experiences about mathematics throughout their education life, and their level of mathematics curiosity and liking mathematics teachers were examined. According to the research results, primary school teacher candidates have a high level of curiosity about mathematics. Besides, sex generally does not affect curiosity in mathematics. Candidate primary school teachers who have negative experience with mathematics are less curious about mathematics. Primary school teacher candidates who like mathematics teachers are more curious about mathematics.

Keywords: Curiosity, Mathematics, Academic Success, Pre-Service Classroom Teachers

1. Introduction

Pediatricians, early childhood educators and policymakers ask 'what are the early social-emotional skills for children to succeed?' They grappled with the question. Curiosity, which is a cornerstone of future life success, is a component of the process that often ends when the knowledge gap that characterizes and leads to knowledge seeking is eliminated with a desire fueled by uncertainty to fill a knowledge gap (Hidi & Renninger, 2020; Peterson & Cohen, 2019). For example, when reading a detective novel, one wonders who the culprit is. Withdrawal likely ensues when the knowledge gap regarding the identity of the offender is closed. Curiosity is satisfied. In other words, when the information search process, which starts with closing the information gap, is resolved, uncertainty and curiosity decrease. As can be observed, curiosity is usually short-lived when the knowledge gap that characterizes it is filled (Hidi & Renninger, 2020). Unless students have a current interest in the content, it is unlikely that a student will return to work with this content (Reio, 2019; Renninger, 2000). In this respect, if there

is no interest, curiosity should step in. There is some theoretical support (Shah, Weeks, Richards, & Kaciroti, 2018) focusing on the fact that curiosity is related to the structure of intrinsic motivation, and that encouraging autonomy, feelings of competence, and connectedness can foster intrinsic motivation and increase curiosity (Shah, Weeks, Richards, & Kaciroti, 2018), but curiosity should also be supported externally. Curiosity, which is the key to learning, is a skill that allows an individual to reveal their potential (Yıldız, 2018). Learning develops in the pursuit of knowledge. If there is a lack of knowledge, the academic success of the student decreases. Therefore, academic success should not be left to chance.

If we look at it from the viewpoint of the different and the subject of the study, expecting only students to be interested in the content to achieve academic success may result in disappointment. In this respect, a student who is not interested in the course should be ensured to keep the curiosity process alive to fill the knowledge gap. For example, lack of knowledge reduces academic success in mathematics (Bayazıt, 2011). The lack of mathematical knowledge of the students since the primary school years causes some misconceptions and difficulties because they build the new knowledge they encounter on the existing knowledge (Kutluca, 2012). At this point, it should be considered important to keep students' curiosity alive.

Considering that curiosity can typically occur in a field-specific manner (for example, in mathematics) (Peterson & Cohen, 2019), pre-service mathematics teachers have problems such as lacking mathematical knowledge and the negative reflection of this lack of knowledge on mathematics teaching results in pre-service teachers' difficulties in how to teach what they have learned in these courses. Curiosity can be seen as a good tool for solving these problems (Yılmaz & Haser, 2018). However, curiosity-focused pedagogy should not only aim to develop children's ability to raise epistemic questions and ideas at school but also develop a positive classroom climate in which children value the importance of education (Lindholm, 2018). In this respect, the importance of pedagogical education increases.

Additionally, depending on the increase in academic success, curiosity is a driving force and a fundamental factor for social and scientific growth (Lindholm, 2018). An important part of this factor is the classroom teachers. It is the teacher who encourages curiosity in the classroom. A child's active participation in the lesson can be ensured in this way. It may even last for a semester. Because unless the child has a previous curiosity in the subject, the probability of stable participation is very low (Hidi & Renninger, 2020). However, students build the new knowledge they encounter in mathematics on their existing knowledge during their primary school years. Classroom teachers are the first mathematics teachers. Examining the changes in their curiosity levels can guide mathematics courses in undergraduate programs. It cannot be expected that the mathematics courses taken by the candidate primary school teachers during their undergraduate education will not be affected by their level of curiosity. Pre-service teachers who learn mathematics do not lack knowledge, and have a lively curiosity can raise students who are interested in mathematics and therefore have a high level of curiosity. Thus, high academic achievement levels in future generations will be inevitable.

This research reveals the level of curiosity in candidate primary mathematics teachers and discusses the precautions to be taken through various variables. The research problems are as follows:
1. What is the level of curiosity of candidate primary mathematics teachers?
2. Does the level of curiosity of candidate primary mathematics teachers differ according to gender?
3. Does the level of curiosity of candidate primary mathematics teachers differ according to the type of high school they graduated from?
4. Does the level of curiosity of candidate primary mathematics teachers differ according to their feelings towards mathematics teachers?
5. Does the level of curiosity of candidate primary mathematics teachers differ according to their negative experiences with mathematics?

2. Method

2.1 Research Design

In the research, the descriptive survey model, one of the quantitative research designs, was used to determine the level of interest in mathematics by candidate primary school teachers. Screening studies constitute for a research model that helps measure attitudes, thoughts and beliefs, determine the relationships between variables, make predictions and determine how subgroups change by using effective measurement tools (Christensen, Johnson, & Turner, 2015). In this direction, the descriptive survey model was used in the research since it was aimed to determine the level of interest in mathematics and the relationships between the variables of the prospective classroom teachers.

2.2 Participants

This research was carried out during the 2021-2022 academic year. The study group of the research consists of 262 primary school teacher candidates studying at state universities located in the south of Turkey. The study group of the research was determined by the criterion sampling method. The basic understanding of this sampling method is to study all cases that meet a predetermined set of criteria. In this context, the criterion taken as the basis is that the study group consists of prospective classroom teachers. Because the "Mathematical Curiosity Scale" used is for classroom teachers and teacher candidates (Usluoğlu & Toptaş, 2021). The demographic information of the primary school teacher candidates participating in the research is presented in Table 1.

Table 1: Demographic information of primary school teacher candidates

Variables	Categories	f
Gender	Female	183
	Male	79
Graduation	Science High School	22
	Anatolian High School	164
	Vocational and Technical Anatolian High School	21
	Imam Hatip High School	16
	Others	39
Negative math experiences	Yes	184
	No	78
Math teacher sympathy	Yes	175
	No	87
Total		262

2.3 Data Collecting and Procedures

In the research, "Mathematical Curiosity Scale for Classroom Teachers and Teacher Candidates" and "Personal Information Form" were used as data collection tools. The scale used was developed by Usluoğlu and Toptaş (2021). It is in a five-point Likert type and consists of 22 items. There were no adverse items on the scale. The ranges for the items in the scale were formed on the basis of five ranges: "I strongly disagree, I disagree, I am undecided, I agree, and I strongly agree." The scale consists of 3 sub-dimensions called "Desire to Know the Unknown," "Seeking for Innovation" and "Desire for Success." There are 11 items in the first dimension, 7 items in the second dimension and 4 in the third dimension. The Cronbach's alpha reliability coefficient for the total scale was calculated as 0.85. Cronbach's alpha reliability coefficient was calculated as 0.81 for the sub-dimensions "Desire to Know the Unknown," 0.79 for "Seeking Innovation" and 0.71 for "Desire for Success." The Cronbach alpha reliability coefficients reached for this study were calculated as 0.93 for the total scale, 0.92 for the “Desire to Know the Unknown,” 0.86 for the “Novelty Seeking” and 0.76 for the “Desire for Success.” Additionally, a Personal Information Form was created by the researchers to determine the personal information of the primary school teacher candidates about gender, high school type they graduated from, positive and negative experiences related to mathematics throughout their education life, and their feelings towards mathematics teachers.

SPSS 25.0 Statistical Package Program was used for statistical operations in the analysis of the data obtained with the Mathematical Curiosity Scale. Frequency, arithmetic mean, standard deviation techniques and difference tests

were used to analyze the data. In this direction, arithmetic mean and standard deviation values were used to determine the mathematical curiosity levels of candidate classroom teachers; difference tests were used to look at the difference between independent mathematical curiosity levels. The Kolmogorov-Smirnov test was applied to determine whether the scores obtained from the whole scale and the scores obtained from the sub-dimensions showed normal distribution. According to the results obtained, it was determined that the scores showed a normal distribution. For this reason, parametric tests were applied.

3. Results

In this section, the findings obtained in line with the sub-problems of the research are presented, respectively. In this context, firstly, the findings related to the level of interest in mathematics according to the demographic characteristics of the primary school teacher candidates are included. Then, the differences in the level of interest in mathematics of the primary school teacher candidates according to the variables of gender, the type of school they graduated from, their experiences related to mathematics and their feelings towards mathematics teachers were explained.

Table 2: Mathematics curiosity levels according to demographic characteristics of primary school teacher candidates

Variables	Categories	f	X	Ss
Gender	Female	183	3.33	0.74
	Male	79	3.50	0.47
Graduation	Science High School	22	2.75	0.63
	Anatolian High School	164	3.48	0.61
	Vocational and Technical Anatolian High School	21	3.10	0.94
	Imam Hatip High School	16	3.11	0.41
	Others	39	3.60	0.62
Negative math experiences	Yes	184	3.16	0.65
	No	78	3.91	0.38
Math teacher sympathy	Yes	175	3.60	0.54
	No	87	2.94	0.71
Total		262	3.38	0.68

When Table 2 is examined, the arithmetic mean of the scores of the candidate classroom teachers' mathematical curiosity levels was found to be X=3.38 and the standard deviation was found to be sd=0.68 in the scale. In the lower dimensions, a level above the average in general is observed. In this context, the opinions of candidate classroom teachers about their mathematical curiosity levels generally correspond to the range of "I agree." In other words, they have a high mathematical curiosity.

Table 3: Independent Samples t-test results of pre-service classroom teachers' mathematical curiosity levels regarding gender

Properties	Gender	n	X	Ss	t	P*
Desire to know the unknown sub-dimension	Female	183	3,28	.06	-1,653	.100
	Male	79	3,47	.06		
Novelty seeking sub-dimension	Female	183	3,27	.06	-2,042	.042
	Male	79	3,49	.07		
Desire for success sub-dimension	Female	183	3,57	.02	-,520	.603
	Male	79	3,60	.04		
Scale total	Female	183	3,33	.05	-1,843	.067
	Male	79	3,50	.05		

**The mean difference was significant at the 0.05 level.*

In Table 3, the results showing whether the scores of the primary school teacher candidates from the mathematical curiosity scale differ according to the gender variable are given. According to the results obtained, it is seen that the gender variable does not create a statistically significant difference between the scores of the students in the total scale, the desire to know the unknown sub-dimension and the desire for success sub-dimension (p> .05). A significant difference between the scores of the novelty seeking sub-dimension according to gender (p < .05) is observed. In this period, it is seen that female classroom teacher candidates have a more mathematical curiosity than male classroom teacher candidates.

Table 4: Independent Samples t-test results of prospective classroom teachers' mathematical curiosity levels regarding negative experiences related to mathematics

Properties	Negative experiences	n	X	Ss	t	P*
Desire to know the unknown sub-dimension	Lived	184	3.05	.06	-10.015	.000
	Never lived	78	4.03	.04		
Novelty seeking sub-dimension	Lived	184	3.12	.05	-7.405	.000
	Never lived	78	3.84	.06		
Desire for success sub-dimension	Lived	184	3.51	.03	-4.207	.000
	Never lived	78	3.74	.03		
Scale total	Lived	184	3.16	.04	-9.591	.000
	Never lived	78	3.91	.04		

**The mean difference was significant at the 0.05 level.*

When Table 4 is examined, the results showing whether the scores obtained from the mathematical curiosity scale of the primary school teacher candidates differ according to the variable of negative experiences related to mathematics are given. According to the results obtained, there is a statistically significant difference between the mathematical curiosity scores of the primary school teacher candidates in the total scale and all sub-dimensions (p < .05). In the whole scale and the sub-dimensions, those without negative experiences with mathematics had higher scores than those who did.

Table 5: Independent Samples t-test results regarding the level of mathematical curiosity of primary school teacher candidates and their liking for mathematics teachers

Properties	Math teachers	n	X	Ss	t	P*
Desire to know the unknown sub-dimension	Likes	175	3.66	.04	10.069	.000
	Doesn't like	87	2.70	.09		
Novelty seeking sub-dimension	Likes	175	3.51	.05	5.297	.000
	Doesn't like	87	2.99	.09		
Desire for success sub-dimension	Likes	175	3.60	.03	1.455	.147
	Doesn't like	87	3.52	.04		
Scale total	Likes	175	3.60	.04	8.258	.000
	Doesn't like	87	2.94	.07		

**The mean difference was significant at the 0.05 level.*

In Table 5, the results show whether the scores of the pre-service teachers from the mathematical curiosity scale differ according to the variable of feelings towards their mathematics teachers. According to the results obtained, a statistically significant difference between the mathematical curiosity scores of the primary school teacher candidates, the total scale, the desire to know the unknown and the sub-dimensions of seeking novelty (p < .05) is observed. On the whole scale and in these sub-dimensions, those who liked the mathematics teacher had higher scores than those who did not. Further, no statistically significant difference between the scores they get from the sub-dimension of desire for success (p> .05) is detected.

Table 5: One-Way ANOVA results of primary school teacher candidates' mathematical curiosity levels regarding school type

Properties	School type	n	X	Ss	sd	f	p	A significant difference*
Desire to know the unknown sub-dimension	Science High School	22	2.51	.17	.81	8.892	.000	A-B, A-E
	Anatolian High School	164	3.44	.06	.77			
	Vocational and Technical Anatolian High School	21	2.98	.26	1.20			
	Imam Hatip High School	16	3.22	.13	.55			
	Others	39	3.63	.11	.74			
Novelty seeking sub-dimension	Science High School	262	3.34	.05	.84	7.116	.000	A-B, A-E
	Anatolian High School	22	2.70	.15	.74			
	Vocational and Technical Anatolian High School	164	3.44	.05	.72			
	Imam Hatip High School	21	3.04	.22	1.00			
	Others	16	3.01	.09	.37			
Desire for success sub-dimension	Science High School	39	3.54	.12	.80	10.481	.000	A-D, B-D, C-D, D-E
	Anatolian High School	262	3.34	.04	.78			
	Vocational and Technical Anatolian High School	22	3.51	.06	.32			
	Imam Hatip High School	164	3.63	.03	.40			
	Others	21	3.54	.05	.26			
Scale total	Science High School	16	3.00	.10	.40	9.075	.000	A-B, A-E
	Anatolian High School	39	3.65	.05	.36			
	Vocational and Technical Anatolian High School	262	3.58	.02	.41			
	Imam Hatip High School	22	2.75	.13	.63			
	Others	164	3.48	.04	.61			

**The mean difference was significant at the 0.05 level.*

(A: Science High School, B: Anatolian High School, C: Vocational and Technical Anatolian High School, D: Imam Hatip High School, M: Others)

When Table 6 is examined, the results of the analysis show that there is a significant difference between the scores obtained in the Mathematical Curiosity Scale in total and in the subgroups and type of high school from which the candidate primary school teachers graduated ($p<.05$). In other words, the mathematical curiosity scores of candidate primary school teachers vary according to the type of high school they graduated from. The results of the Scheffé Test, which was conducted to determine between which groups the difference occurs, are displayed as follows:

Science High Schools have a statistically significant difference in favor of Anatolian High Schools (A/B) and other types of high schools (A/E) in sub-dimensions of willingness to know the unknown and seek novelty. In the sub-dimension of desire for success, Imam Hatip High Schools have a statistically significant difference in favor of Science High Schools (A/D), Anatolian High Schools (B/D), Vocational and Technical Anatolian High Schools (C/D) and other types of high schools (D/E). A statistically significant difference in the total scores of the scale in favor of Science High Schools, Anatolian High Schools (A/B) and other types of high schools (A/E) is observed.

4. Discussion

It is claimed that curiosity has a positive effect on learning (Gruber, Gelman, & Ranganath, 2014; Lindholm, 2018; McGillivray, Murayama, & Castel, 2015; Peterson, 2020; Reio, 2019; van Schijndel, Jansen, & Raijmakers, 2018). Many studies have reported that students who are claimed to be curious are more often have better academic success (Post & Walma van der Molen, 2018; Reio Jr & Wiswell, 2000; Wavo, 2004) than students who are reported to have less curiosity. Again, in a study on curiosity and academic achievement, it was concluded that mathematics achievement is significantly related to curiosity (Shah et al., 2018).

Research to understand curiosity, education, psychology, human-computer interactions, robotics, neuroscience, and medicine is becoming more interdisciplinary with new information from researchers in the related fields. Using this accumulated information presents an incredible opportunity and improves education by encouraging curiosity. Ways to encourage curiosity in the classrooms are initiatives in educational field (Jirout, Vitiello, & Zumbrunn, 2018). From this perspective, the results of this study, which reveal the level of interest in the candidate primary mathematics teacher, discuss the measures to be taken over various variables and contribute to the field of mathematics learning, show that the level of mathematics curiosity is at the level of *I agree*. In other words, it's a positive dimension. Besides, this is promising for the field of learning mathematics.

Among the results of the study (except for the novelty seeking sub-dimension), the level of interest in the candidate primary mathematics teachers did not differ significantly according to the gender variable. In other words, sex generally does not affect the interest in mathematics.

Another result of the study is that the mathematical curiosity levels of the candidate primary mathematics teachers make a difference according to whether they have negative experiences related to mathematics or not. Candidate primary school teachers who have negative experience with mathematics are less curious about mathematics.

Another result is that the mathematical curiosity levels of the candidate primary school teachers make a difference according to whether they like their mathematics teachers or not. Having a look at the results of the study (except for the sub-dimension of desire for success), it is observed that pre-service teachers who like mathematics teachers are more curious about mathematics.

In the study, it was concluded that primary school teacher candidates have a high level of mathematics. These results will be shared with the lecturers from whom the participants take mathematics courses. Maybe faculty members can reflect on their mathematics achievements at the end of the semester according to their level of mathematics curiosity. This may encourage them to conduct new research.

Classes are complex systems in which many factors can stimulate children's curiosity. It's important, then, to incorporate this complexity into the encouragement of curiosity. As a way of encouraging the implementation of research, the researcher will encourage the participants from whom he collected the research data.

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