



A Longitudinal Study of the Attitudes of Early Childhood Pre-service Teachers towards Mathematics

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ARTICLE INFO

Article History:

Received 03.02.2016

Received in revised form

02.03.2016

Accepted 11.04.2016

Available online

01.05.2016

ABSTRACT

As in many countries, early childhood teachers introduce mathematics content in kindergartens in Turkey. Therefore, early childhood teachers should master a certain level of mathematics knowledge and are offered a mathematics methods course in faculties of education. Teacher training programs are also expected to improve early childhood preservice teachers (PSTs) attitudes towards mathematics (ATM). In this context, it seems important to investigate whether and how much early childhood PSTs' attitude towards mathematics changed throughout their university lives. Our study was conducted with a sampling of 43 participants studying at a state university in the north of Turkey, in the Black Sea Region. The data was collected from early childhood PSTs using the same attitude scale in their 1st and 3rd years of study. The quantitative analysis of the data in SPSS 22 using t-test for paired samples demonstrated that the early childhood PSTs' attitudes towards mathematics have improved from the 1st to the 3rd year. In our sampling, one-way ANOVA and t-test for independent samples revealed that the ATM of the early childhood PSTs were not associated with variables such as gender, the type of completed high school, total family income, and parents' level of education. Based on the findings, it was concluded that the mathematics methods course offered to early childhood PSTs in their 2nd year might be effective in improving the attitudes towards mathematics.

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Keywords:

Early childhood preservice Teachers (PSTs), Attitudes towards Mathematics (ATM), Longitudinal Study, Mathematics methods course

1. Introduction

Vacc and Bright (1999) claim that the attitudes and views of preservice teachers (PSTs) about mathematics are shaped long before they enter universities. Most of these attitudes are negative and resistant to change (Book et al., 1983; Feiman-Nemser et al., 1988; Weinstein, 1989). These negative attitudes are found to be a result of numerous negative former student experiences (Tabachnick and Zeichner, 1984). Some studies also showed that the attitudes of preservice teachers remain unchanged during the course of university life and sometimes they get worse (Feiman-Nemser et al., 1987).

Faculties of education should address these issues and develop positive attitudes towards mathematics (ATM) since evidence shows that it's not all about the teachers themselves. Many studies demonstrated that there is a positive correlation between teachers' positive ATM and their instructional performance (Chester and Beaudin, 1996; Mewborn ve Cross, 2007; Thompson, 1992), their pupils' achievement (Lake and Kelly, 2014; Lindgren, 1995; McLeod, 1994; Pehkonen, 1994; Schram et al., 1988) and motivation (Vinson, 2001).

When it comes to early childhood PSTs, the problem seems to be a deeper one. First, it should be noted that there's a growing interest to teach an ever increasing amount of mathematics content (Aydin, 2009). However,

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<http://dx.doi.org/10.17220/ijpes.2016.02.003>

most of early childhood PSTs are shown to have chosen the profession because they don't like mathematics and don't find themselves good at mathematics (Lake and Kelly, 2014). Early childhood teacher education programs focus on emotional, physical and social development mostly at the expense of academic subjects such as mathematics (Lee and Ginsburg, 2009) and even worse, some programs may see teaching mathematics as harmful in early childhood (Elkind, 1981; 1998). In this context, there's every reason to hypothesize that early childhood PSTs mostly enter teacher education programs with negative attitudes towards mathematics and leave the university with the same or even worse attitudes. This problem may have some serious consequences like bad attitudes imply bad pupil achievement, motivation, etc.

If we take the contrapositive, i.e. the logical equivalent of this hypothesis, we could state that early childhood PSTs obviously need to have positive ATM to successfully perform their duties. Based on the assumption that the teacher training programs have the responsibility to develop these attitudes, many treatment studies focused on how to improve early childhood PSTs' ATM (Jones, Lake and Dagli, 2005; Lake and Kelly, 2014; Yesil-Dagli, Lake and Jones, 2010). Mathematics methods courses found in most early childhood teacher training programs are shown to focus only on improving ATM or reducing mathematics anxiety (Burroughs, 2007; Mewborn and Cross, 2007). For example, in a series of studies the researchers have shown that during mathematics methods course in the university process of early childhood PSTs, the ATM were shown to improve (Lake, Jones and Dagli, 2004; Lake and Kelly, 2014; Lake, Vives and Jones, 2004; Jones, Lake and Dagli, 2003; 2005; Yesil-Dagli, Lake and Jones, 2010).

While this is the case in the world, little evidence was found from Turkey. In the only relevant study in Turkish context, Tarım and Bulut (2006) showed that early childhood teachers had negative ATM before they started the profession but these negative attitudes toward mathematics improved as they realized that the mathematics they have to teach is simpler than they previously thought. The researchers of the same study suggest that it was not obvious whether teacher preparation program has anything to do with improving early childhood teachers' ATM. In fact, the total body of related literature does not seem to provide us with sufficient data about the university process and its effects on the attitude of early childhood PSTs' toward mathematics when no special intervention is designed and implemented. In our study, it was intended to find new evidence about this relationship.

In our developmental study, no special intervention is used though, the early childhood PSTs in Turkey are offered a mathematics course in their 2nd year (or in some universities in their 3rd year) and this course may have some effect on early childhood PSTs attitude toward mathematics. In this regard, we're convinced that determining the attitudes of early childhood preservice teachers in 1st and 3rd years of their studies and investigating whether and how these attitudes changed from the 1st through the 3rd year is an important research question which may increase our understanding in the above mentioned relationship. Therefore our null and alternative hypotheses are as follows:

H0: The attitudes of early childhood PSTs towards mathematics do not change from the 1st to the 3rd year.

H1: The attitudes of early childhood PSTs towards mathematics change from the 1st to the 3rd year.

1.1. Belief constructs

When investigating attitudes, it's very important first to properly conceptualize the term attitude. Teacher beliefs are usually investigated under different names such as "teachers' instructional criteria", "principles of practice", "perspectives", "conceptions", "knowledge", "views" or "attitudes" (Clandinin and Connelly, 1987). We will try to define the term attitude properly and state the underlying assumptions clearly.

This study will investigate the attitudes of early childhood preservice teachers (PSTs) towards mathematics. For this aim, we have preferred the definition of "attitude" suggested by Maio and Haddock (2010). They define "attitude" as a summary evaluation about a stimulus object which can be anything from an ice-cream to mathematics. Attitudes about the same object which can be translated simply as "to like or dislike the object" have two important attributes as "strength" and "direction" Maio and Haddock (2010). In a similar fashion, Rokeach (1968), defines attitude as the cluster of beliefs developed about a certain object or event and is predisposed to respond in a specific way.

In line with their definition, Maio and Haddock (2010), assert that attitude has three components: a) cognitive information, b) affective information and c) behavioral information. These components seem to cap all relative belief constructs in the literature by assuming that they all serve under one of the components of attitude. For example all kinds of beliefs, views, cognitions and etc. about mathematics can be classified as cognitive information forming up the cognitive domain of attitude. Likewise, all fears, anxieties, self-perceptions and etc. about mathematics can be classified as emotional information forming up the affective domain of attitude. Similarly all previous experiences and behaviors about mathematics can be sorted as behavioral information constituting the behavioral domain of attitude.

The attitude researches are alleged to start with the efforts of several social psychologists. One of the most famous founders of attitude research, Gordon Allport believes that attitude is probably the most distinctive and indispensable concept in American social psychology (Allport, 1937, p.198).

There are different streams of attitude research all of which warrant further inquiries. The most visible and current attitude research deals with what attitudes are, how are they formed and changed. This paper adheres to the third line of research.

1.2. Attitude Scales

As stated by LaPiere (2010), attitude scales are commonly used to assess the attitudes of individuals because, they are easy, cheap and feasible. On the other hand, assessing real human behaviours is usually very expensive, exhaustive and time-consuming. Indeed, surveys are considered at best as being able to identify symbolic responses to symbolic situations. All attitude researches using attitude scales have the presumption that there's a one to one correspondence between symbolic responses and real human behaviours.

After "attitude" is clearly defined and limitations of attitude scales are considered, the investigation of the attitudes of early childhood PSTs towards mathematics using attitude scale is thought to be more comprehensible.

1.3. Mathematics Methods (Teaching Mathematics) Course

In this study, a paper and pencil explicit attitude scale was used. As stated by LaPiere (2010), attitude scales are commonly used to assess the attitudes of individuals because, they are easy, cheap and feasible. On the other hand, assessing real human behaviours is usually very expensive, exhaustive and time-consuming. Explicit measures of attitudes are also called as direct measures which are extremely popular (Krosnick, Judd and Wittenbrink, 2005)

There are of course other measures which are called as implicit (indirect) measures of attitudes. They have their own strengths and weaknesses. Implicit measures of attitudes do not necessitate directly asking the participants for a verbal report. Although this may be seen as an advantage it does not guarantee obtaining the most reliable answers from the participants. On the other hand they are usually very expensive to administer and difficult to interpret.

After "attitude" is clearly defined and limitations of attitude scales are considered, the investigation of the attitudes of early childhood PSTs towards mathematics using a self-reported paper and pencil measure of attitude is thought to be more comprehensible.

1.4. Research questions

1. Do the attitudes of early childhood PSTs towards mathematics show significant differences in their 1st year of study in terms of gender, type of completed high school, family income, father's level of education, and mother's level of education?
2. Do the attitudes of early childhood PSTs towards mathematics show significant differences in their 3rd year of study in terms of gender, type of completed high school, family income, school, family income, father's level of education, mother's level of education and the grade obtained from the mathematics course in the 2nd year of study?
3. How did these attitudes change from the 1st to the 3rd year of study?

2. Method

This study has a longitudinal design. Longitudinal and cross-sectional studies are the fundamental methods of collecting data on human development. The data can be analyzed then using correlational or factorial designs. This type of research tests the same sampling repeatedly. In a longitudinal study, the same participants are observed several times and the change or consistency in their behaviors are recorded.

On the other hand, the environmental effects on the participants cannot be controlled between the measurements and the participants may lose interest in the study (Çepni, 2007). This type of research may not be generalizable.

After considering all these pros and cons of the longitudinal design, this type of study was found appropriate for our research concerns and sampling. In this way, we will be able to investigate the change in the attitudes of early childhood PSTs towards mathematics from their 1st to 3rd year.

2.1. Data Collecting Tools

This paper reports the findings of a study which made use of an attitude scale consisting of 42 items. The attitude scale was developed by Alkan et al. (2004) and its reliability and validity was shown on 450 secondary students. The reliability of the scale was shown to be 0,95. The scale consisted of 4 factors such as "Affective Dimension", "Cognitive Dimension", "Application Dimension" and "Belief Dimension". These factors were shown to explain %44,2 of the total variance which consisted of % 23,02, %8,32, %6,88 and %6,05 consecutively. The factor loadings for the four factors were shown to be between 0,338 and 0,767; 0,342 and 0,666; 0,361 and 0,724; 0,385 and 0,609 consecutively. The scale was also used for PSTs in several studies (Bukova, 2006; Mandacı Şahin, 2007).

In this study, the scale was conducted to 51 (40 females, 11 males) early childhood PSTs in their 1st year. Then the same scale was applied to 43 (36 females, 7 males) of the same 51 early childhood PSTs in their 3rd year.

In addition to the attitude scale, a number of questions seeking demographic information were asked to the participants such as "What is your total family income?", "What is the education level of your parents?", "Which type high school have you graduated from?", "Gender?", "Which mark did you take from the mathematics course in the 2nd year?" etc. These questions aimed at determining whether these independent variables led to significant changes in attitudes.

2.2. Participants

Convenience sampling method was used in this study. All of the students in the selected year of the sample university were invited to the study. The sampling of the study was consisted of 51 (40 females, 11 males) in the first data collection, and 43 (36 females, 7 males) of the same 51 early childhood PSTs in the second data collection, pursuing a degree in a state university, in the north of Turkey, in the Black Sea Region. The attitudes of the same group was assessed both in their 1st and 3rd year of studies.

2.3. Data Analysis

In order to determine the effects of several independent variables such as gender or total family income in the attitudes of early childhood PSTs towards mathematics in years 1 or 3, t-test for Independent Samples or one-way ANOVA were used. The t-test for independent samples is used to reveal the effects of a continuous independent variable with two levels on a continuous dependent variable. For example, the effect of gender on the attitudes of early childhood PSTs towards mathematics. And one-way ANOVA is used to reveal the effects of a continuous independent variable with more than two levels on a continuous dependent variable. For example, the effect of parents' education level on the attitudes of early childhood PSTs towards mathematics.

Table 1. General Properties

	N	Male	Female
First Year	51	40	11
Third Year	43	36	7

Variables	Number of Levels	Levels
Gender	2	Male Female
School Type	3	Vocational Sch. High School Spec. High Sch.
Income	3	1000-2500 2500-5000 5000-
Education Level of the Father or Mother	4	Primary High School Undergraduate Graduate

Additionally, in order to determine the change of attitudes between years 1 and 3; t-test for paired samples was used. Pre-test and post-test designs on a single sampling are usually analyzed using t-test for paired samples.

3. Findings and Discussion

3.1. Findings

Research Problem #1: Do the attitudes of early childhood PSTs towards mathematics show significant differences in their 1st year in terms of gender, type of completed high school, family income, father's level of education, and mother's level of education?

The hypotheses regarding the first research problem were stated as follows:

Ho: There is no statistically significant difference in the attitudes of early childhood PSTs towards mathematics in their 1st year in terms of gender.

H1: There is a statistically significant difference in the attitudes of early childhood PSTs towards mathematics in their 1st year in terms of gender.

Similar hypotheses were constructed for the other independent variables such as the type of completed high school, family income, father's level of education, and mother's level of education. And moreover, for all independent variables the variances were found homogenous by using Levene test.

Table 2

Gender	N	Mean (M)	Std. Deviation	df	t	Sig. (2-tailed)
Male	7	158,429	27,652	41	,747	,459
Female	36	151,528	21,325			

(*) $p < .05$

When we look at the results of independent t-test for gender we see that there's no statistically significant difference in the attitudes of early childhood PSTs towards mathematics in their 1st year in terms of gender ($F = 0,684$, $df = 41$, $q = 0,459$).

Table 3

ANOVA Results		Sum of Squares (SS)	df	Mean Square (MS)	F	Sig.			
High Sch. Type	Between	124,412	2	62,206	,120	,887			
	Within	20659,355	40	516,484					
	Total	20783,767	42						
Income	Between	182,712	2	91,356	,177	,838			
	Within	20601,055	40	515,026					
	Total	20783,767	42						
Edu. level	Between	620,460	3	206,820	,400	,754			
	Mother	Within	20163,308	39			517,008		
		Total	20783,767	42					
		Between	463,719	3			154,573	,297	,828
	Father	Within	20320,048	39			521,027		
		Total	20783,767	42					

The results of the one-way ANOVA tests also revealed that there were no statistically significant differences in the attitudes of early childhood PSTs towards mathematics in their 1st year in terms of completed high school types ($F = 0,120$, $df = 2$, $q = 0,887$), total family income ($F = 0,177$, $df = 2$, $q = 0,838$), father's level of education ($F = 0,297$, $df = 3$, $q = 0,828$), or mother's level of education ($F = 0,400$, $df = 3$, $q = 0,754$).

Research Problem #2: Do the attitudes of early childhood PSTs towards mathematics show significant differences in their 3rd year in terms of gender, type of completed high school, family income, father's level of education, mother's level of education, and the grade obtained from the mathematics course in the 2nd year?

The hypotheses regarding the second research problem were stated as follows:

Ho: There is no statistically significant difference in the attitudes of early childhood PSTs towards mathematics in their 3rd year in terms of gender.

H1: There is a statistically significant difference in the attitudes of early childhood PSTs towards mathematics in their 3rd year in terms of gender.

Similar hypotheses were constructed for the other independent variables such as the type of high school, family income, father's level of education, mother's level of education, and the grade obtained from the mathematics course in the 2nd year. And moreover, for all independent variables the variances were found homogenous by using Levene test.

Table 4

Gender	N	Mean (M)	Std. Deviation	df	t	Sig. (2-tailed)
Male	7	169,000	16,104	41	,716	,478
Female	36	163,083	20,611			

(*) $p < .05$

When we look at the results of independent t-test for gender we see that there's no statistically significant difference in the attitudes of early childhood PSTs towards mathematics in their 3rd year in terms of gender ($F = 1,929$, $df = 41$, $q = 0,478$).

Table 5

ANOVA Results		Sum of Squares (SS)	df	Mean Square (MS)	F	Sig.	
High Sch. Type	Between	523,233	2	261,616	,650	,528	
	Within	16106,674	40	402,667			
	Total	16629,907	42				
Income	Between	153,187	2	76,593	,186	,831	
	Within	16476,720	40	411,918			
	Total	16629,907	42				
Edu. Level	Between	81,580	3	27,193	,064	,979	
	Mother	Within	16548,327	39	424,316		
	Total	16629,907	42				
The grade from the mathematics course in 2nd year	Between	580,423	3	193,474	,470	,705	
	Father	Within	16049,484	39	411,525		
	Total	16629,907	42				
The grade from the mathematics course in 2nd year	Between	463,609	3	154,536	,373	,773	
	Within	16166,298	39	414,520			
	Total	16629,907	42				

(*) $p < .05$

The results of the one-way ANOVA tests also revealed that there were no statistically significant differences in the attitudes of early childhood PSTs towards mathematics in their 3rd year in terms of completed high school types ($F = 0,650$, $df = 2$, $\eta^2 = 0,528$), total family income ($F = 0,186$, $df = 2$, $\eta^2 = 0,831$), father’s level of education ($F = 0,470$, $df = 3$, $\eta^2 = 0,705$), mother’s level of education ($F = 0,064$, $df = 3$, $\eta^2 = 0,979$), or the grade obtained from the mathematics course in the 2nd year ($F = 0,373$, $df = 3$, $\eta^2 = 0,773$).

Research Problem #3: How did the attitudes of early childhood preservice teachers towards mathematics changed from their 1st through 3rd year?

The hypotheses of the study regarding the 3rd research problem were stated as follows:

Ho: There is no statistically significant difference in the attitudes of early childhood PSTs towards mathematics between their 1st and 3rd years of study.

H1: There is a statistically significant difference in the attitudes of early childhood PSTs towards mathematics between their 1st and 3rd years of study.

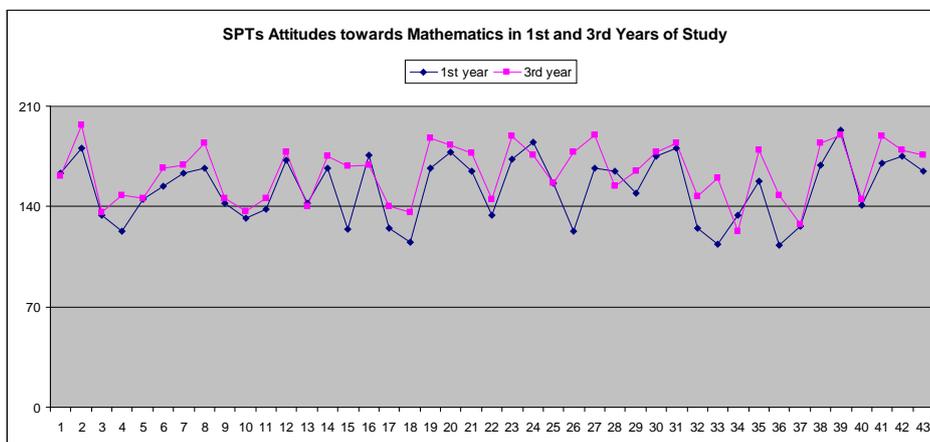
Table 6

Paired Samples Test Results	N	Mean	Std. Deviation	df	t	Sig. (2-tailed)
First Year	43	152,651	22,245	42	-5,158	,000
Third Year	43	164,047	19,899			

(*) $p < .05$

According to the results of t-test for paired samples ($N = 43$, $t = -5,158$, $df = 42$, $\eta^2 = 0,000$) we refuse the null hypothesis Ho and accept the alternative hypothesis H1. Thus, there is a statistically significant difference in the attitudes of early childhood PSTs towards mathematics between their 1st and 3rd years of study.

Figure 1.



3.2. Discussion

Our study showed that the attitudes of early childhood PSTs’ towards mathematics in their 1st year improved through time and became more positive through their 3rd year. This finding is in line with the results of the work by Tarım and Bulut (2006), which suggested that the attitudes of early childhood teachers towards mathematics improved from their first year in the university through their upper years. They also claimed that these attitudes kept improving as the early childhood teachers start working in schools and see that the mathematics of early childhood is quite different from what they saw in their own primary and high school lives. The similar finding in our study made us think that, the mathematics course in the 2nd year of these student teachers and the other theoretical developments via university education might have helped them

realize that preschool mathematics is quite different, more enjoyable and easier than advanced level of mathematics which challenged them in their early school lives as a student. Again, the work of Phillippou and Christou (1998) on improving the attitudes of student class teachers towards mathematics via a series of university mathematics courses revealed that university mathematics courses can enable making the student class teachers towards mathematics more positive. Similar results were shown also for student elementary and secondary mathematics teachers in numerous studies (Ashton and Webb, 1986; Chester and Beaudin, 1996).

Moreover, we have found in our study that the type of high school student teachers graduated from, parents' level of education, total family income and the mark obtained from the mathematics course taken by the student teachers in their 2nd year made no difference in their ATM in their 1st years or 3rd years. This finding aligns with the results of both studies (Tarım and Bulut, 2006; Phillippou and Christou, 1998).

4. Conclusions and Recommendations

Firstly, it should be noted that our study is limited with 43 participants. In addition, it should be noted that explicit measures of attitude always run the risk of social desirability issues. On the other hand, if we consider that the findings reflect the reality with best approximation, we can interpret our results in the following way:

The attitudes of early childhood PSTs towards mathematics in their 1st year improved and became more positive through year 3. One of the factors contributing to this improvement in ATM might be the mathematics course offered in the 2nd year. The real reasons behind this improvement warrant further control of relevant variables.

Future inquires may concentrate on exploring the existence and nature of such kind of relationship.

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