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Procedia - Social and Behavioral Sciences 141 (2014) 1270 – 1274

Procedia
Social and Behavioral Sciences

WCLTA 2013

Visual Preferences And Teaching Anxiety Of Preservice Mathematics Teachers

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Abstract

Calculus courses and the topics like differentiation and integral in these courses are important for secondary mathematics teacher candidates. Because these courses construct both a basis for the following mathematics courses and cover the topics which preservice teachers will teach when they became a teacher. In addition, the visual preferences of preservice teachers are closely related to the teaching methods they use. The aim of this study is to determine the visual preferences of preservice teachers in the content of integral and to determine the relationship between the teaching anxiety about mathematics. Furthermore the effects of grade level and GPA scores on mathematics teaching anxiety and visual preferences of preservice mathematics teachers will be determined. The study was carried out in 2012-2013 academic year with preservice mathematics teachers grade level 2-5 in a university in Turkey.

Selection and peer-review under responsibility of the Organizing Committee of WCLTA 2013.

Keywords: Visual preference, integral, mathematics teaching;

1. Introduction

When learning mathematics, students are expected to develop different viewpoints and to use them during problem solving. One of the duties of teachers is to help the students gain these viewpoints. However, there are other variables involved in this process. Visual preference is one of them. Visual preference is defined as students' use of visual and non-visual methods in their problem solving attempts (Presmeg, 1999). Visual preference affects individuals' behavior not only in learning mathematics but also in teaching it. Teaching visuality, which is another concept related to visualization, is defined as teachers' using visual methods and encouraging students' in using

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Selection and peer-review under responsibility of the Organizing Committee of WCLTA 2013.
doi:10.1016/j.sbspro.2014.05.219

them (Presmeg, 1999). In a research conducted by Presmeg (1991, cit. in Presmeg, 2006), the effect of teaching visuality of teachers, whose visual preference ranges from visual to non-visual, on students were determined. Students of teachers, who are in the middle group according to their teaching visuality, were more successful. Therefore, a teacher's views on mathematical initiative determines his/her in-class activities, thus the nature of the class environment he/she creates (Philipp, 2007), and this environment also shapes students' beliefs on the nature of mathematics (Schoenfeld, 1992; Hiebert & Grouws, 2007; Peker & Mirasyedioğlu, 2003).

One of the affective concepts influential on students' learning mathematics is mathematics anxiety. Mathematics anxiety is defined as experiencing anxiety and nervousness which hinders mathematical problem solving and using numbers in daily and academic life (Richardson & Suinn, 1972, cit. Yüksel Şahin, 2004). Teachers' attitudes towards mathematics and mathematics teaching are effective in students' attitudes and mathematics anxieties (KarakaşTürker &Turanlı, 2008; Yüksel Şahin, 2004). Thus, affective factors teachers have in relation to mathematics influence the way they teach.

Analysis, whose history goes back to ancient times, is one of the keystones of mathematics and a means for developing advanced mathematical thinking skills. The importance of analysis for mathematics is indisputable. In order to understand the concepts underlying its foundation, it should be related to other mathematical subjects such as algebra, geometry, and trigonometry, and it is like a "stepping stone" for the following topics. Its importance is also reflected in mathematics teaching, and there is an increase in the number of studies on this topic. In college mathematics, using multiple displays has regained importance, especially in teaching concepts in fundamental classes such as analysis (Tucker and Leitzel,1995; cit. in Stylianou & Silver 2004). The importance of multiple displays, not only in college mathematics but also on high school level is emphasized with the fact that there is an item related to displays in NCTM's (National Council of Teachers of Mathematics) "principles and standards for school mathematics" (Stylianou & Silver, 2004). Not only mathematics teachers but also mathematicians are aware of the cognitive importance of visual expressions (Mancosu, 2005). Therefore, visual preferences of pre-service teachers while learning and teaching analysis are important for their students.

1.1. Aim of the study

The aim of this study is to determine the visual preferences of preservice teachers in the content of integral and to determine the relationship between the teaching anxiety about mathematics. Furthermore the effects of grade level and GPA scores on mathematics teaching anxiety and visual preferences of preservice mathematics teachers will be determined.

1.2. Sample of the study

The study was carried out in 2012-2013 academic year with 104 preservice mathematics teachers grade level 2-5 in a university in Turkey. Distribution of students in grade levels and gender can be seen in table 1.

Table 1. Distribuition of student in grade levels and gender

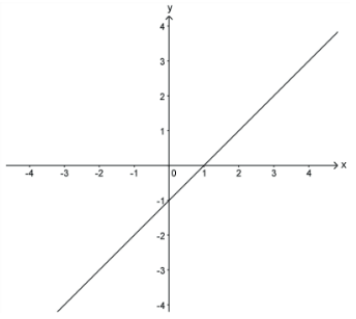
	Grade Level				
Gender	2.Grade	3.Grade	4.Grade	5.Grade	Total
Boys	5	7	6	8	26
Girls	25	12	24	17	78
Total	30	19	30	25	104

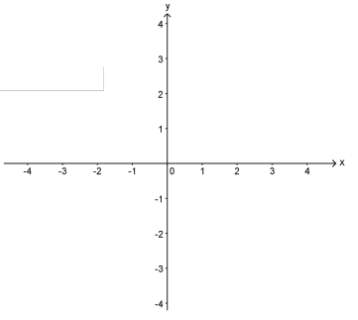
1.3. Data sources and analysis

Data sources of the study consist of two instruments: Mathematical Processing Instrument for Calculus (MPIC) Antiderivative-Quetionaire (7 tasks) and Algebraic-Questionaire (3 tasks) which was developed by Haciomeroglu and Chicken (2011) and Mathematics Teaching Anxiety Scale (MATAS) which was developed by Peker (2006)

were used. One of the example for antiderivative and algebraic tasks in MPIC were given below.

Antiderivative Task 1: Graph is shown. Please sketch a possible graph from which this given derivative could be drawn.





Questionaire:
How did you solve it?
There are different ways to determine these answers. On this questionnaire we want to know how you determined your answers.
Every task has two possible methods of solution. It does not matter whether you completed the solution or not or whether your answer is right or wrong. If your solution is similar to one of the methods, please choose the MAIN method that was useful to you, although the other method(s) was considered.
A) I estimated the equation of the graph (or recognized the equation of the graph).
For example: This could be the graph of $f'(x) = x - 1$ so I computed the integral as $f(x) = \frac{x^2}{2} - x + c$ and drew the derivative graph using this equation.
B) I used the *y* values to estimate the slopes (or the slopes of tangent lines) at various points on the graph and used this to draw the graph of the antiderivative.
For example:

- The *y* values (or the slopes of tangent lines) are negative and approaching zero as *x* approaches *1* from the left.
- The *y* value (or the slope of the tangent line) is zero at *x =1*.
- The *y* values (or the slopes of tangent lines) are positive and increasing as *x* approaches positive infinity.

C)Other: You may use some other method. Please describe.

Algebraic Task 1: Given $f'(x) = |x+1|$, sketch a possible graph of the antiderivative $f(x)$.
How did you solve it?
There are different ways to determine these answers. On this questionnaire we want to know how you determined your answers.
Every task has two possible methods of solution. It does not matter whether you completed the solution or not or whether your answer is right or wrong. If your solution is similar to one of the methods, please choose the MAIN method that was useful to you, although the other method(s) was considered.
A) I calculated an integral or derivative, and used this to draw a possible graph of the antiderivative.
B) I first drew the graph of $f'(x)$. Then, I used the *y* values to estimate the slopes (or the slopes of tangent lines) at various points on the graph and used this to draw a possible graph of the antiderivative.
C) Other: You may use some other method. Please describe.

The MATAS is a likert-type questionnaire consist of 23 items. The participants were asked to rate the statements on a five-point scale: completely agree, agree, undecided, disagree, or completely disagree. The negative statements were weighted from 5 to 1, and positive statements were reversed. Beside instruments genders, GPA scores and grade levels of participants were asked. One-way ANOVA with α=0.05 in the analysis of the differences of pre-

service teachers' teaching anxieties in mathematics based on visual preferences was employed.

2. Results

Nearly all of the students who take part in the study have non visual preferences for calculus (n=100 non-visual preference for calculus). The mean score of the participants' teaching anxiety of is $\overline{X} = 1,9$(max=3,22; min=1). According to one-way ANOVA results (Table 2) that there was a statistically significant difference among the pre-service teachers'teaching anxiety based grade levels [F =3.516, p<.05]. According to the results of the Tukey HSD test, there was a statistically significant difference in mathematics teaching anxiety between third-fourth and third-fifth grade levels (third-fourth, p=0.042<0.05; third-fifth, p=0.042<0.05). This difference was in favour of fourth and fifth grade level.

Table 2. One-Way ANOVA Results for the Pre-service Teachers' Mathematics Teaching Anxiety by grade levels

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2,254	3	,751	3,516	,018
Within Groups	21,374	100	,214		
Total	23,629	103			

Table 3. The Descriptive for Pre-service Teachers' Mathematics Teaching Anxiety by grade level

	N	df	Mean Square
2	30	1,9928	,39784
3	19	2,1442	,57627
4	30	1,7812	,46820
5	25	1,7670	,43057
Total	104	1,9051	,47896

Correlations between mathematics teaching anxiety mean scores, grade levels and GPA scores can be seen in Table 4. There is statistically significant low negative correlation (r=-,234) between teaching anxiety mean scores and grade levels.

Table 4. Corelations between Pre-service Teachers' Mathematics Teaching Anxiety, grade level, and GPA scores

		Teaching anxiety	Grade level	GPA score
Teaching anxiety	Pearson corre.	1	-,234(*)	-,074
	Sig (2-tailed)		,017	,455
Grade level	Pearson corre.	-,234(*)	1	,176
	Sig (2-tailed)	,017		,074
GPA score	Pearson corre.	-,074	,176	1
	Sig (2-tailed)	,455	,074	

* Correlation is significant at the 0.05 level (2-tailed).

3. Discussion and conclusions

The aim of this study was to determine the visual preferences of preservice teachers in the content of integral and to determine the relationship between the teaching anxiety about mathematics. But nearly all of the participants had non visual preferences for calculus. Therefore the relationship between mathematics teaching anxiety and visual preferences for calculus of preservice teachers couldn't be determined. In fact students' tendency for non visual methods was known from the previous researches. But this preference is not always about their way of thinking, but also their way of learning and to be taught. Since the participants of the study share the same culture (instructor they

took analysis courses, similar classroom environments and so on), their preference for the visual methods could be formed in similar ways. Because according to some researches (Presmeg, 1999; Eisenberg & Dreyfus,1991) it is a learning phenomenon.

Mathematics teaching anxiety of preservice teachers decreases in later year during their education. This drop is statistically meaningful for 3-5 and 3-4 grade levels. It is very likely about the increase of their pedagogical content knowledge and mathematic knowledge. But there is no relationship between their GPA score mathematics teaching anxiety.

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