

Pre-Service Elementary School Teachers' Learning Styles and Attitudes towards Mathematics

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The purpose of this study was to investigate the differences of pre-service elementary school teachers' attitudes towards mathematics according to their learning styles. Two hundreds eighty one pre-service elementary school teachers were involved in this study. The researchers employed two types of instruments, Learning Style Inventory and Scale of Mathematics Attitude Questionnaire, to collect the data. The learning style inventory was designed to detect the participants' learning styles, Divergent, Assimilator, Convergent, and Accommodator, and the scale of mathematics attitude questionnaire was used to find the participants' attitudes towards mathematics. After the collection of the data, the researchers run the one-way ANOVA to show the attitude differences based on the learning styles. The study concluded that there were statistically significant differences found between the attitudes of learners, convergent and assimilator, and that the convergent learners had more positive attitudes towards mathematics than the assimilator learners.

Keywords: Learning Styles, Attitudes; Mathematics, Pre-Service Elementary School Teacher.

INTRODUCTION

Students' low success level in mathematics has been a worry for a long time in many countries. There are a lot of factors affecting success in mathematics. One of these factors is students' mathematical anxiety, in other words, their mathematical fear. One of the reasons for mathematical anxiety is attitude towards mathematics (Baloğlu, 2001). Students that have high mathematics anxiety also have negative attitudes towards their success are low in mathematics (Biller, 1996). It is determined that individuals' attitudes towards mathematics may effect their careers in the mathematical sciences in the future. Since families' beliefs about mathematics may also effect their

children's beliefs, families have responsibilities to their children's positive beliefs (Shoffner, & Vacc, 1999). It is clear that the encouraged students have affirmative attitudes towards mathematics (Hartog, & Brosnan, 1994). In order to make the attitudes affirmative, a great number of factors should be considered. Grouws & Cebulla (2000) state that the use of concrete materials for a long time, especially in the primary education period, is positively related to increasing students' mathematics success and developing positive attitudes towards mathematics. It is fact that decreasing students' prejudices about mathematics will be effective in developing affirmative attitudes. In addition being from different ethnic groups, nations, and sexes effect on the attitudes towards mathematics (Tocci & Engelhard, 1991; Strutchens, 1995; Odell & Schumacher, 1998). Is learning style one of the factors which affect the attitudes towards mathematics? In other words, do pre-service elementary school teachers' attitudes towards mathematics differ according to their learning styles? Since little research has been done in the area of learning style and attitudes towards mathematics of pre-

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service elementary school teachers, this research was undertaken to add that body of knowledge.

Due to the implementation of traditional instruction, many students find it difficult to adapt to learning environments that, in some situations, have conflicted with the students' values, attitude, and belief systems (Jones, Reichard & Mokhtari, 2003; Dede, 2006). Learning style research has indicated that students succeed academically in learning environments that match their learning styles (McCarthy, 1987; Kolb, 1984). In some of the research done (Peker, 2003a), it is found that the students' attitudes towards mathematics show differences according to the learning styles. Is this case valid for the candidate teachers of the future? If this is so, we, the instructors in universities, who educate them, have important roles and responsibilities. In this research, the difference in attitudes towards mathematics among pre-service elementary school teachers according to learning styles was investigated. Kolb's and McCarthy's learning styles are taken into consideration. It is stated that Kolb's and McCarthy's learning styles are similar. This similarity is given in table 1 (Peker, Mirasyedioğlu & Aydın, 2004, p.74). It is believed that the learning model most applicable to learning mathematics is Kolb's model of experiential learning (Knisley, 2002). In this model, perceiving and processing of knowledge is critically important. Student learning styles can help us understand students' difficulties in perceiving and processing mathematical concepts. This is in line with the claim of Knisley (2002) stated that teachers and educators should consider students learning styles in their teaching mathematics.

If learners are to be effective they need ability in four different areas: Concrete experience, reflective observation, abstract conceptualization, and active experimentation. That is, they must be able to involve themselves fully, openly, and without bias in new experiences for concrete experience. They must be able to reflect on and view these experiences from many perspectives for reflective observation. They must be able to create concepts that integrate their observations into logically sound theories for abstract conceptualization. They must be able to use these theories to make decisions and solve problems for

Table 1. The Similarity of Kolb's and McCarthy's Learning Styles

<i>Kolb's Learning Styles</i>	<i>McCarthy's Learning Styles</i>
Diverger	Imaginative learner
Assimilator	Analytic learner
Converger	Common sense learner
Accommodator	Dynamic learner

active experimentation (Kolb, 1984). In Kolb's model, a student's learning style is determined according to whether the student's prefers of perceiving information from the concrete to the abstract, and whether the student's prefers of processing information active experimentation to reflective observation. These preferences result in a classification scheme of the student's learning styles. But the student may have discovered that no single mode entirely describes his/her learning style. This is because each person's learning style is a combination of the four basic learning abilities. (Kolb, 1984; 1985). Kolb identified four different learners as follows: Divergent learners (diverger), assimilator learners (assimilator), convergent learners (converger), accommodator learners (accommodator) [See figure 1]. Divergent learners learn by combining concrete experience with reflective observation. They can view concrete situations from various viewpoints. Assimilator learners learn by combining abstract conceptualization with reflective observation. They thrive putting the information in logical form. Convergent learners learn by combining abstract conceptualization with active experimentation. They take abstract ideas and actively experiment to find practical uses for the information by finding solutions to the problems. Accommodator learners learn by combining concrete experience with active experimentation. They take concrete experiences mixed with active experimentation in a hands-on experience.

These learning styles are not absolute, and all learners, regardless of preference, can function in all four learning styles when necessary (Kolb, 1984). Listed below (figure 2) are the strengths of the four learning style types (Kolb, 1984; 1985; Baker, Dixon & Kolb, 1985).

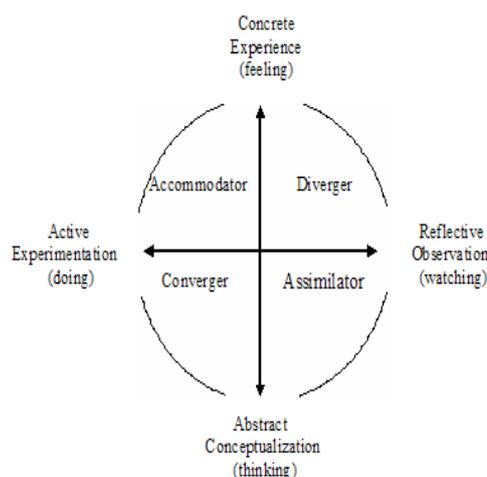


Figure 1. Elements of Kolb's Learning Styles (Kolb, 1984).

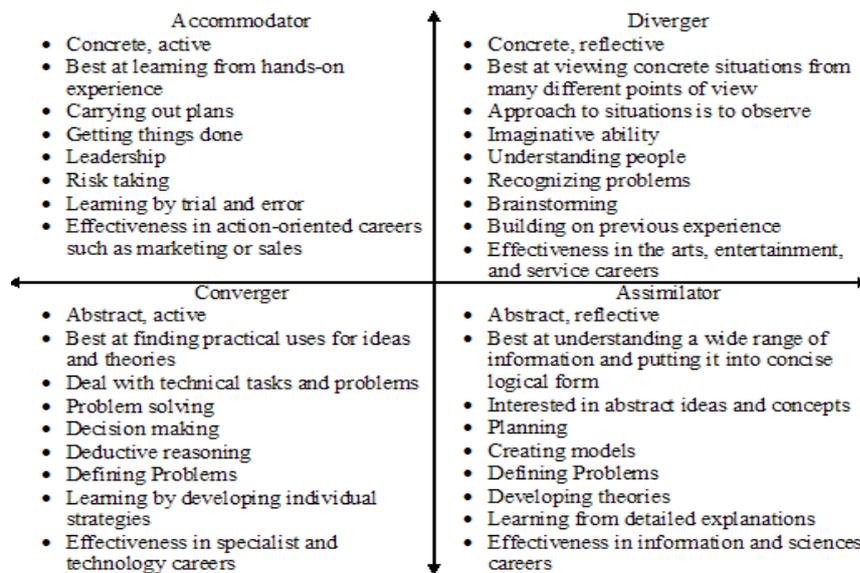


Figure 2. The strengths of the four learning style types

According to Kolb, “A major function of education is to shape students’ attitudes and orientations towards learning— to instill positive attitudes towards learning and a thirst for knowledge, and to develop effective learning skills” (Kolb, 1984, p.85).

The purpose of this study is to investigate the differences of pre-service elementary school teachers’ attitudes towards mathematics according to their learning styles. Namely, the main problem of the research is the question of whether pre-service elementary school teachers’ attitudes show differences according to their learning styles. Since little research has been done in the area of learning styles and attitudes towards mathematics among pre-service elementary school teachers, this research is undertaken to add to this area. Besides, this study would help teacher educators know better their students learning preferences and attitudes towards mathematics.

METHODS

Participants

The research involved 281 pre-service elementary school teachers who have been enrolled in Elementary Teacher Education at the Faculty of Education in two Universities in Turkey. The pre-service teachers are students, that is, pre-service teachers enrolled in teacher education programs. 54.4 % of the pre-service elementary school teachers were female, and 45.6 % of the pre-service teachers were male.

Instruments

Two instruments were used to obtain the data: The Learning Style Inventory and the Scale of Mathematics

Attitude. Learning Style Inventory which had been developed by Kolb (1985) in order to determine pre-service elementary school teachers’ learning styles, and had been adapted in Turkish by Aşkar & Akkoyunlu (1993), was used. The Learning Style Inventory (LSI) describes the ways people learn and how people deal with ideas and day-to-day situations in their life. The LSI is a 12 item questionnaire in which respondents attempt to describe their learning style. Each item asks respondents to rank order four sentence endings that correspond to the four learning modes— concrete experience, reflective observation, abstract conceptualization, and active experimentation (see, Kolb, 1985). Norms of Learning Styles Inventory were applied for determining pre-service elementary school teachers’ learning styles. The Scale of Mathematics Attitude, which was developed by Aşkar (1986), was used to determine pre-service elementary school teachers’ attitudes towards mathematics. The Scale of Mathematics Attitude consists of twenty statements, 10 positive and 10 negative, such as “I like studying mathematics”, “I suffer when I go to mathematics classroom”, “mathematics is less-liked course among others”, “mathematics is an enjoyable course”, and so forth. The internal consistency coefficient (Cronbach Alpha) of Mathematics Attitude scale was .95.

Procedure

Unlimited time was allowed for each testing session, with most pre-service teachers finishing the scale of Mathematics Attitude within 10, the LSI within 15 minute. Statistical Package for Social Science (SPSS) was used to analyze the data. While the answers given to the negative items in the Scale of Mathematics Attitude are 5=just suitable, 4=suitable, 3=undecided, 2=unsuitable, 1=just unsuitable, they are inverted at grading and

reconsidered as 1=just suitable, 2=suitable, 3=undecided, 4=unsuitable, 5=just unsuitable. The highest point of attitude is identified as 100, while the lowest is 20 for 20 items. While calculating points of pre-service elementary school teachers' attitudes towards mathematics, the total points according to the criteria determined above at the 20-item scale are considered. Norms of Learning Styles Inventory were applied for determining pre-service teachers' learning styles and the evaluation was done by taking the percentage and frequency for the distribution of learning styles. The One-Way ANOVA procedure produces a one-way analysis of variance for a quantitative dependent variable by a single factor (independent) variable. In addition to determining that differences exist among the means, you may want to know which means differ. Hence, One-Way-ANOVA was carried out at the analysis of the difference of pre-service teachers' attitudes towards mathematics according to their learning styles.

RESULTS

In the following findings appeared by the result of obtained data analysis is presented as tables and interpretations are done according to the relevant tables.

Learning Styles of Pre-service Elementary School Teachers

The distribution of learning styles of pre-service elementary school teachers is given in Table 2. When the percentage distribution of pre-service elementary school teachers whose learning styles are determined, it is seen that more than the half of the students (55.5 %) are assimilator learners, and more than the quarter (28.1 %) are convergent learners. Divergent learners and accommodator learners are a little group. In the research done by Peker (2003a) among the tenth grade students who have mathematics lesson the distribution of the learning styles are as follows, 13.9 % are divergent learners, 54.2 % are assimilator learners, 26.1 % are convergent learners, 5.8 % are accommodator learners. Another research conducted by Peker & Aydın (2003) in Anatolian High School and High School of Science on

Table 2. The Percents and Frequency of Pre-service Elementary School Teachers' Learning Styles

	<i>f</i>	%
Divergent Learners	32	11.4
Assimilator Learners	156	55.5
Convergent Learners	79	28.1
Accommodator Learners	14	5.0
Total	281	100

tenth grade students, it is defined that 10.9 % are divergent learners, 54.5 % of the students are assimilator learners, 29.4 % of the students are convergent learners, 5.2 % of the students are accommodator learners. In another research done for examining the pre-service mathematics teachers' learning styles, it is seen that nearly more than half of the pre-service teachers were assimilator learners (58.8 %), 1/3 of the students were convergent learners (31 %). Divergent (5.9 %) and accommodator (4.3 %) learners were so low at rate (Peker, Mirasyedioğlu & Aydın, 2004). Peker (2005) determined that more than half of the primary mathematic teacher education students were assimilator learners (65.8 %), quarter of them were convergent learners (25.8 %), 5.2 % of them were divergent learners, 3.2 % of them were accommodator learners. It is seen that the findings in our research show similarity with the findings in the other researches.

The Differences of Pre-service Elementary School Teachers' Attitudes towards Mathematics According to Their Learning Styles

The findings obtained by making One-Way-ANOVA are given in the table 3 and table 4. When table 3 is examined, it is seen that the arithmetical mean of the assimilator learners' points of attitudes towards mathematics is the lowest ($\bar{x}=78.53$). The convergent learners' is the highest ($\bar{x}=87.10$). The findings of One-Way-ANOVA showing the difference between pre-service elementary school teachers' attitude points according to their learning styles are given in table 4.

When table 4 is examined, it is seen that pre-service elementary school teachers' points of attitudes towards mathematics show a significant difference according to their learning styles. Namely, pre-service teachers' attitudes towards mathematics change according to their learning styles. Pre-service teachers' learning styles are categorized in to four items: divergent learners, assimilator learners, convergent learners, accommodator learners. The result of ANOVA shows that there is a significant difference in pre-service teachers' attitudes towards mathematics according to the learning style variant. The means of attitude points according to pre-service teachers' learning styles was examined. The results of the Tukey-HSD multi-comparison test, which was applied, in order to designate significant differences according to the learning styles, are between the groups which were investigated. There was a significant difference between convergent learners' and assimilator learners' attitude points. It is seen that according to table 3 this difference is in favor of convergent learners. It is revealed that convergent learners have more affirmative attitudes towards mathematics than the assimilator learners. According to the research done by

Table 3. The Descriptive for Pre-service Elementary Teachers' Attitude Points Related to Learning Styles

	N	\bar{X}	SD
Divergent Learners	32	80.25	11.542
Assimilator Learners	156	78.53	14.061
Convergent Learners	79	87.10	10.700
Accommodator Learners	14	85.00	11.482
Total	281	81.46	13.296

Table 4. One-Way ANOVA Results for the Difference of Pre-service Elementary Teachers' Attitude Points According to Their Learning Styles

	Sum of Squares	df	Mean Squares	F	p
Between Groups	4079.607	3	1359.869		
Within Groups	45422.087	277	163.979	8.293	.000***
Total	49501.694	280			

***p<.001

Peker (2003a), the existence of the relationship between learning styles and the students' attitudes towards mathematics lesson, among high school tenth grade students was examined. Significant differences were found between divergent learners and assimilator learners' attitudes and between divergent learners and convergent learners' attitudes. It was defined that this difference was for the assimilator and convergent learners.

DISCUSSION AND CONCLUSIONS

At the end of the research, it is seen that 11.4% of pre-service elementary school teachers are divergent learners, 55.5% of them are assimilator learners, 28.1% of them are convergent learners, and 5% of them are accommodator learners. Findings of research showed that pre-service elementary school teachers are mostly from the assimilator learners. In Turkey, where traditional instruction is generally applied, it is seen that learning styles appropriate to this instruction method (namely, that which is geared towards assimilator learners and convergent learners) takes too much place (Peker, 2003a).

The analysis of One-Way ANOVA about the attitudes of pre-service elementary school teachers towards mathematics demonstrated that there was a statistically significant difference found among learning styles [$F_{(3,277)}=8.293$, $p<.001$]. These differences were between assimilator learners and convergent learners. It also found that the difference was in favor of convergent learners. It is thought that such a result is revealed because convergent learners find the traditional instruction more appropriate to themselves than the others do. In the procedure of functional view, it can be seen as natural that convergent learners have more affirmative attitudes. This result supports the findings of Peker (2005) and Peker, Mirasyedioğlu and Yalın (2003). According to Peker (2005), convergent learners were the

most successful ones among pre-service elementary mathematics teachers. In addition, Peker, Mirasyedioğlu and Yalın (2003) showed that assimilator and convergent 10th graders instructed with learning preferences of assimilator and convergent performed better in mathematics classroom than their peers who were divergent and accommodators. In other words, this current study documented that students given an instruction based on their learning styles and preferences showed better performance and positive attitudes towards mathematics than students given an instruction designed not on their learning styles and preferences.

As a result, one of the factors which affect the attitudes towards mathematics is learning style. Students in the classroom have more than one learning style (Peker, 2003b). The students who have other learning styles expect instruction appropriate to themselves. Students are capable of functioning in all four learning styles, but the preferred learning style of a student varies from topic to topic and concept to concept. If this is so, then what can be done about this? One of the factors effecting students' mathematics achievement is their attitudes towards mathematics, and one of the factors effecting students' attitudes towards mathematics is learning style. Teachers must know about learning styles and their students' particular learning styles. Teachers must apply to their students' lesson plans considering the learning styles.

Like many researchers (Stice, 1987; Wilkerson & White, 1988; Morris & McCarthy, 1990; McCarthy, 1990; Blair & Judah, 1990; Harb, Durrant & Terry, 1993; Knisley, 2002) we hope that learning cycle (or 4 MAT system) constructed according to different learning styles will improve mathematics achievement and attitudes towards mathematics among the students. The students can find all the features of four types and also the difference between their successes depending on learning styles can be eliminated by applying 4 MAT

system by McCarthy. The 4 MAT system was prepared by considering all four types. Therefore, there will be a learning covering for all the learning styles. The main responsibility belongs to the teachers and to the educators of the teachers. Teachers must know that learning style affects success and all the teachers and candidates must be aware of all learning styles.

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