Pre-Service Elementary School Teachers' Attitude Towards Geometry

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This study explores pre-service elementary school teachers' attitudes toward their learning of geometry. Fifty-six pre-service elementary school teachers who were enrolled in a mathematics content course for elementary and early childhood program completed the Utley Geometry Attitude Scales (UGAS) to measure attitudes of pre-service elementary teachers toward geometry. UGAS uses a Likert type scale where participants make subjects responds, on a scale of one to five, to their degree of agreement with a statement. A high score represents more indicative of an overall positive attitude towards geometry. The UGAS subscale data on the mean scores of the confidence of learning geometry scale, usefulness of studying geometry scale, and the enjoyment of studying geometry scale were 3.29, 3.65, and 2.83, respectively. The participants had a mean composite survey score of 3.25 on the 5-point Likert scale, with a score of one representing the most negative attitude, a score of three representing a neutral position, and a score of five representing the most positive attitude. Therefore, the mean composite score that reflected attitudes was just above the neutral position. The correlations among the three subscales were all statistically significant ($p < 0.01$). There appears to be a significant relationship between usefulness of studying geometry, enjoyment of learning geometry, and confidence of learning geometry in pre-service teachers. A significant relationship also appears to be ($p < 0.01$) between self-report grade and usefulness of studying geometry and confidence of learning geometry in pre-service teachers. Unfortunately, many pre-service elementary teachers in the study did not exhibit positive attitudes toward geometry learning. The lowest mean score for attitudes was the enjoyment of studying geometry scale in learning geometry at 2.83. The result also showed that the majority of the pre-service elementary teachers did not like solving geometrical problems. It also emerged that geometry was not a difficult topic and that, though most students did not like solving geometry, they considered geometry useful. The study revealed that the pre-service elementary teachers' attitudes toward the usefulness of geometry were moderately positive and that many of them believed that geometry was a valuable and necessary topic which could help them in their future careers and education. Recommendations for exposing pre-service teachers to positive attitudes about geometry are discussed.

Keywords: attitudes, geometry, achievement, pre-service teachers

Introduction

The National Council of Teachers of Mathematics (NCTM) stated that, "Geometry is a natural place for the development of students' reasoning and justification skills, where students should understand that a part of the beauty of mathematics is that when interesting things happen it is usually for a good reason" (NCTM, 2000).

Although much effort had been made in teaching geometry, numerous researches made it clear that students were not learning geometry as they were expected to learn and encounter difficulties, and performed poorly in geometry (Clements & Battissa, 1992; Geddes & Fortunato, 1993; Mitchelmore, 1997; NCTM, 1989; Thirumurthy, 2003). Moreover, students' geometry achievement was always lower than the other areas of Mathematics (Mammana & Villiani, 1998; Burton, 1999). It has been also observed that students shy away from the study of geometry, which shows the negative attitude and poor performance of students in geometry (Betiku, 2001).

Attitudes play an important role in students' geometry achievement. Attitude is often considered in educational research, since the development of a positive attitude is desirable because of its association with higher achievement scores (Papanastasiou, 2000). Similarly, if students have positive attitudes toward geometry, they are expected to like geometry, participate in the classroom activities and be high achievers in geometry (Bindak, 2004). Thompson (1993) defined attitude as a learned pattern of manners that was developed through one's environment. In particular, Utley (2004) defined attitude towards geometry as a set of beliefs focusing on geometry that predisposed a person to respond in a certain way. The attitudes of students can be influenced by the attitudes of teachers and their methods of teaching.

Literature Review

The research showed that the teachers' methods of geometry teaching and their personalities greatly accounted for the students' positive attitudes toward geometry and that, without interest and personal effort in learning geometry, pupils can hardly perform well in the topic (Thompson, 1993). Primary school teachers' attitudes toward geometry influence their students' attitudes. Students with a positive attitude are more likely to develop their mathematical problem solving skills, thus developing positive attitudes toward mathematics. Geddes and Fortunato (1993) documented that many students encountered difficulties and performed poorly in geometry. Forgasiz (2005) found that students had greater confidence about their geometric skills and were aware of its usefulness. They had a more positive perception of the topic. The study is aimed at investigating pre-service elementary school teachers' attitudes toward the learning of geometry.

Teacher education programs intend to prepare elementary pre-service teachers to develop knowledge and skills for teaching mathematics effectively. This research would help teacher educators to explicitly address specific aspects of dispositional issues in mathematics content courses for teaching geometry, which could have the potential to support their learning of geometry. Further, it describes how this can provide an opportunity to incorporate program changes that could provide pre-service teachers with an opportunity to gain positive attitudes toward geometry. There are three research questions that will be answered in the study:

1. What are the attitudes toward geometry of pre-service elementary school teachers entering the second mathematics methods course? In particular, how are pre-service teachers' scores on each of the three attitudinal components measured: confidence of learning geometry, usefulness of studying geometry, and the enjoyment of studying geometry?
2. What are the relationships among the three measures of attitude towards geometry for pre-service elementary teachers?

3. What is the relationship between elementary pre-service teachers' mathematics grades and attitudes toward learning geometry?

Methodology

Participants

The population of this study consisted of pre-service elementary school teachers at a mid-sized, four-year state university in a mid-sized town in the Southern Minnesota. The sample was composed of students in two sections of entry level mathematics methods course. Fifty-six participants from these two classes completed data collection tasks during the Spring 2015 semester for the study. Among the 56 participants, eight were male and 48 were female.

Instrument and Procedure

The Utley Geometry Attitude Scales (UGAS) was developed after extensive review of a variety of existing instruments used to measure attitudes toward mathematics (Utley, 2004) and was designed to measure the attitudes of undergraduate college students toward geometry. The UGAS is containing 32 self-report scale items, including 17 positively and 15 negatively worded items. The UGAS was developed by Juliana Utley and was used with his permission in this study. UGAS uses a Likert type scale where participants make subjects responds, on a scale of 1 to 5, to their degree of agreement with a statement. The response choices are: "Strongly disagree = 1 point," "Disagree = 2 points," "Neutral = 3 points," "Agree = 4 points," and "Strongly agree = 5 points." Table 1 shows a sample of the UGAS items. A high score represents more indicative of an overall higher attitude toward geometry.

Table 1

Sample of UGAS

Subscales	Statements
Usefulness of study of geometry	I believe that I will need geometry for my future.
	Geometry has no relevance in my life.*
Confidence to learn geometry	I am sure that I can learn geometry concepts.
	I lack confidence in my ability to solve geometry problems.*
Enjoyment of learning geometry	When I leave class with a geometry question unanswered, I continue to think about it.
	Geometry problems are boring.*

Note. * Item negatively worded.

UGAS included three subscales as confidence of learning geometry (12 items, e.g., "I am sure that I can learn geometry concepts"), usefulness of studying geometry (10 items, e.g., "I can see ways of using geometry concepts to solve everyday problems"), and the enjoyment of studying geometry (10 items, e.g., "Solving geometry problems is enjoyable"). Table 2 shows three subscales with items of the UGAS. Possible student scores on the UGAS range from 32 to 160. Higher scores on the UGAS indicate more favorable attitudes toward geometry. A measure of internal consistency was calculated for the UGAS and each of its subscales. The Cronbach's alpha reliability coefficient for the UGAS was 0.96. The Cronbach's coefficient alpha was 0.95 for the confidence subscale, 0.93 for the usefulness subscale, and 0.92 for the enjoyment subscale. The last two questions were concerned with gender and grades.

Participants were informed of the purpose of the study and solicited to participate. All participants were informed that there would be no penalty for refusal to participate in the study and that those agreeing to

participate were ensured the confidentiality of their responses. Participants were asked to complete the UGAS during the same time period. Although participants were not given a time limit, all participants were finished completing both surveys within 15 minutes. Those participant surveyed with items unanswered were eliminated from the analysis.

Table 2

Subscales of UGAS

Subscales	Contained items
Usefulness of studying geometry	2, 10,12, 17, 19, 20, 24, 26, 28, 31
Confidence of learning geometry	1, 5, 8, 9,11, 13, 18, 21, 22, 27, 29, 32
Enjoyment of learning geometry	3, 4,6, 7, 14,15,16, 23, 25, 30

Results and Discussion

Table 3 shows the response of pre-service teachers' grades. They reported the grades they usually get in mathematics class with A (25%), B (41.1%), C (26.8%), and D (7.1%).

Table 3

Response of Pre-Service Teachers' Grades

	Self-report grade			
	A	B	C	D
The Grade I usually get in mathematics class is:	25%	41.1%	26.8%	7.1%

Table 4 displays the mean scores and standard deviations on the UGAS by subscales for the 56 participants. The UGAS subscale data on the mean scores of the confidence of learning geometry scale, usefulness of studying geometry scale, and the enjoyment of studying geometry scale were 3.29, 3.65, and 2.83 respectively. The participants had a mean composite survey score of 3.25 on the 5-point Likert scale, with a score of one representing the most negative attitude, a score of three representing a neutral position, and a score of five representing the most positive attitude. Therefore, the mean composite score that reflected attitudes was just above the neutral position. Unfortunately, many pre-service elementary teachers in the study did not exhibit positive attitudes toward learning geometry.

Table 4

Means of Subscale, Overall Mean, and Standard Deviation of UGAS (N = 56)

Subscale	Quantity	Mean (M)	Standard deviation (SD)
Usefulness of geometry	10	3.65	0.98
Confidence to learn geometry	12	3.29	0.68
Enjoyment of learning geometry	10	2.83	0.74

Note. Negatively items have been scored reversely.

The mean score of the usefulness of geometry learning subscale was 3.65. This represents attitudes that are somewhat positive, indicating that they had only moderately positive attitude scores about usefulness of geometry learning currently and in relationship to their future education, vocation, or other activities. Examples of these included: "I believe that I will need geometry for my future," "I often see geometry in everyday things," and "I will need a firm understanding of geometry in my future work." The mean scores for the items were 3.80, 3.25, and 3.71, respectively. The views expressed by preservice elementary school teachers are similar with Bindak

(2004) who realized geometrical knowledge as essential not only for living effectively in the society, but also for making useful contributions to the development of one's environment. This agreed with Mogari's (1999) study that defined geometry as a particularly powerful and concentrated example of the functioning of human intelligence.

Pre-service elementary teachers' confidence in their ability to learn geometry had a mean score of 3.29, which was slightly above the neutral position. Six of the items had mean scores below the neutral position of 3.0, and six items had mean scores above 3.0. Examples of questions with a favorable attitude, from the confidence level form, were: "I am sure that I can learn geometry concepts" and "I feel sure of myself when doing geometry problems." The mean scores for the two items were 4.40 and 2.91, respectively. An answer of disagree on six negatively stated comments indicated a favorable attitude. Examples of this include: "I often have trouble solving geometry problems" and "For some reason even though I study, geometry seems unusually hard for me." Both of these items appear to indicate low self-confidence. The result confirms that the lack of confidence in mathematics is related to the actions of pre-service elementary teachers (Soodak & Podell, 1996). Forgasiz's (2005) study also reported that students had greater confidence about their geometric skills and were aware of its usefulness. They had a more positive perception of the topic. Unfortunately, many pre-service elementary teachers in the study did not exhibit confidence in their ability to learn geometry.

The mean score of the enjoyment of learning geometry was 2.83. The highest-scoring item for enjoyment, "When I start solving a geometry problem, I find it hard to stop working on it," had a mean rating of 3.03. This item reflected an attitude slightly above the neutral position, indicating that these preservice teachers did not particularly enjoy solving geometry problems. The lower-scoring items for enjoyment were: "Geometry problems are fun" and "Solving geometry problems is enjoyable." The mean scores for these two items were 2.71 and 2.69, respectively. This indicates a negative attitude, these future elementary school teachers did not especially enjoy geometry. Nine of the 10 enjoyment items had mean scores less than the neutral position of 3.0, reflecting negative attitudes concerning liking and enjoying geometry. This result implies that pre-service teachers did not like solving geometrical problems, which concurred with Gardner (1983) who discovered that students' geometry achievement was found to be affected by students who did not like solving geometry problems.

Information gained from the UGAS can provide educators with a useful means of assessing students' attitudes toward geometry (see Table 5). By examining the overall responses of students, educators can gain a general sense of their attitude and then by examining scores on the individual subscales, they can gain an understanding of their students' confidence to learn geometry, usefulness in studying geometry, and enjoyment to learn geometry. These scores can be used to examine a variety of relationships, such as the relationship between students' attitudes and achievement in geometry. Table 6 displays pearson correlation coefficient between the subscales of UGAS. Pearson correlations were calculated among the three subscales and self-report grade, which has been presented in Table 3. The correlations among the three subscales were all statistically significant ($p < 0.01$). A significant relationship appears to be between usefulness of studying geometry, enjoyment of learning geometry, and confidence of learning geometry in pre-service teachers. The result confirms the findings of Forgasiz (2005) that students had greater confidence about their geometric skills and were aware of its usefulness, they had a more positive perception of the topic.

Table 5

Mean of Responses of UGAS (N = 56)

Subscales	Item No.	Mean
Usefulness of studying geometry	2. I believe that I will need geometry for my future.	3.80
	10. Geometry has no relevance in my life.	3.66
	12. Geometry is not a practical subject to study.	3.78
	17. I can see ways of using geometry concepts to solve every day problems.	3.26
	19. Geometry is not worthwhile to study.	3.64
	20. I often see geometry in everyday things.	3.25
	24. I will need a firm understanding of geometry in my future work.	3.71
	26. I do not expect to use geometry when I get out of school.	3.82
	28. I will not need geometry for my future.	3.98
	31. Geometry is a practical subject to study.	3.64
Confidence of learning geometry	1. I am sure that I can learn geometry concepts.	4.40
	5. I often have trouble solving geometry problems.	2.82
	8. I am confident I can get good grades in geometry.	4.05
	9. When I cannot figure out a geometry problem, I feel as though I am lost and cannot find my way out.	2.92
	11. I lack confidence in my ability to solve geometry problems.	3.23
	13. I feel sure of myself when doing geometry problems.	2.91
	18. For some reason even though I study, geometry seems unusually hard for me.	2.83
	21. Geometry problems often scare me.	3.28
	22. I am confident that if I work long enough on a geometry problem, I will be able to solve it.	4.03
	27. Geometry tests usually seem difficult.	2.66
Enjoyment of learning geometry	29. I can usually make sense of geometry concepts.	3.35
	32. I have a lot of confidence when it comes to studying geometry.	2.92
	3. Geometry problems are boring.	2.89
	4. When I leave class with a geometry question unanswered, I continue to think about it.	2.98
	6. When I start solving a geometry problem, I find it hard to stop working on it.	3.03
	7. Time drags during geometry class.	2.83
	14. Geometry is fun.	2.71
	15. I just try to get my homework done for geometry class in order to get a grade.	2.66
	16. Geometry is an interesting subject to study.	2.85
	23. Solving geometry problems is enjoyable.	2.69
	25. Working out geometry problems does not appeal to me.	2.78
	30. Geometry has many interesting topics to study.	2.94

Note. Negatively items have been scored reversely.

Table 6

Pearson Correlation Coefficient Between the Subscales of UGAS

	Usefulness of studying geometry	Confidence of learning geometry	Enjoyment of learning geometry	Self-report grade
Usefulness of studying geometry	1.000	-	-	-
Confidence of learning geometry	0.380*	1.000	-	-
Enjoyment of learning geometry	0.541*	0.586*	1.000	-
Self-report grade	0.360*	0.322*	0.083	1.000

Note. * $p < 0.01$.

There also appears to be a significant relationship ($p < 0.01$) between self-report grade and usefulness of studying geometry and confidence of learning geometry in pre-service teachers. The result confirms that

attitude is often considered in educational research, since the development of a positive attitude is desirable because of its association with higher achievement scores (Papanastasiou, 2000). Similarly, if students have positive attitudes toward geometry, they are expected to like geometry, participate in the classroom activities, and be high achievers in geometry (Bindak, 2004). The findings of this present study support Gardner's (1983) investigations that students' geometry achievement was found to be affected by students who did not like solving geometry problems. Attitudes play an important role in students' geometry achievement.

Conclusion

The UGAS subscale data on the mean scores of the confidence of learning geometry scale, usefulness of studying geometry scale, and the enjoyment of studying geometry scale were 3.29, 3.65, and 2.83, respectively. The average survey scores were highest or most positive for usefulness of studying geometry scale, with a mean score of 3.65. The lowest or most negative scores were for enjoyment, with a mean score of 2.83. These pre-service teachers, as a whole, valued geometry and viewed it as important, but they did not enjoy geometry or feel self-confident about geometry. Geometry is one of the most important branches of mathematics. This should be a concern for teacher educators, because teachers with negative attitudes toward geometry are unlikely to cultivate positive attitudes in their own students. Improving pre-service students' attitudes toward mathematics is an important concern for university education courses in order to facilitate positive mathematics attitudes in future elementary students. Improving the attitudes of pre-service elementary school teachers is a crucial step in breaking the cycle of teachers with negative attitudes fostering negative attitudes in their own students (Philippou & Christou, 1998).

As mathematics teacher educators, we should develop and evaluate strategies directed at improving students attitudes to geometry subjects, which include a strong relation between geometry contents and students everyday experiences; learning opportunities to integrate difference pre-existing knowledge, a variation in teaching methods; and enhancing cooperation and communication in the classroom. We are conscious that we have a long way to go, to learn, to experiment, and to reflect on our options when we decided on methodologies and tasks to present and challenge pre-service teachers, but the goal is to make them become more knowledgeable and developing positive the attitudes and confident in geometry.

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