

The Effects of Using an Interactive Software (GSP) on UAE Students' Attitudes towards Geometry

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ABSTRACT

This study investigated the effects of using the Geometer's Sketchpad (GSP) software on the UAE math teachers' and students' Attitudes towards Geometry. The sample consisted of 8 math teachers and 98 students (males and females) in grade 9 from Al-Ain Educational Zone in UAE. The researcher trained the teachers in the study on the use of GSP. After that, the teachers, in turn, trained the students on the use of the software. The participants completed an attitude questionnaire pre- and post- use of the software. The results of the study showed significant differences in students' attitudes towards geometry. They showed more positive attitudes after using the GSP than before using it in geometry classes. The results also revealed that most of the 9th grade students in the experimental had positive attitudes towards geometry.

Keywords: *Geometer's sketchpad, Attitudes, Geometry.*

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1. INTRODUCTION

The National Council of Teachers of Mathematics emphasized the importance of using technology in the teaching and learning of mathematics; “Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students’ learning.” (National Council of Teachers of Mathematics (National Council of Teachers of Mathematics (NCTM), 2000).

The Geometer's Sketchpad (GSP) software was developed for math teachers and students. It can be used in many math courses including: pre-algebra, algebra, geometry, pre-calculus and calculus. This tool facilitates both students' and teachers' visualization and exploration of mathematics concepts. Its dynamic features can support students' conceptual development by exploring geometric patterns and relationships (Bonsangue, 1997). It can create a rich mathematical environment in which students can explore and promote a conjecturing spirit that is fundamental for advancement in math learning (Manouchehri *et al.*, 1998).

Research studies indicated that students enjoyed using the GSP software and reported feeling in charge of their learning when using it (Scher, 2000; Hannafin *et al.*, 2001; McClintock *et al.*, 2002). Some studies focused on students’ attitudes (Growman, 1996; Pokay and Tayeh, 1997; Yousef, 1997; Akyuz and Turk, 2016) while others focused on students’ achievement (Lester, 1996; McClintock *et al.*, 2002; Author, 2005). Other studies focused on the effective use of GSP in a variety of mathematics classes: Purdy (2000) used GSP to visualize maximum-volume problems; Quinn (1997) used GSP in teaching graph theory in her discrete-mathematics class and Embse (2001) used GSP to construct dynamic graphs of functions in calculus.

The results of some of the studies indicated that after using GSP, students developed more positive attitudes towards the software itself, as well as toward mathematics. Pokay and Tayeh (1997) found that students felt uncomfortable and frustrated with the language of the GSP when they initially used it, but developed a positive attitude after that. In another study on the use of the GSP in a geometry course for secondary education Mathematics majors, Growman (1996) found that both students and instructors had more positive attitudes towards testing conjectures when they used GSP. Akyuz and Turk (2016) studied the effects of GSP on eighth grade students' achievement in geometry and their attitudes toward geometry and technology. The results indicated that using the GSP had a significant effect on students' attitudes toward both geometry and technology.

Yousef (1997) conducted a study to investigate the effects of using the GSP on high school students’ attitudes towards geometry. The results indicated that the scores of the pretest and posttest of the students in the experimental group were significantly different. There was also a significant difference between the achievements of the control group vs the experimental group.

Lester (1996) investigated the effects of the GSP software on high school students’ understandings of geometric knowledge. The results indicated that the mean of posttest scores of the experimental group for the dependent variable (geometric conjectures) was significantly higher in comparison to the mean of the posttest of the control group. In addition to that, Lester’s study brought forward the importance of preparing teachers in effectively using the new technologies and software in instruction.

McClintock *et al.* (2002) conducted a qualitative study on students’ development of 3D visualization in the Geometer’s Sketchpad environment. The students explored geometric solids among other concepts using GSP for a period of time that lasted between 10 to 20 weeks. They found that the students developed a more effective 3D visualization skills and achieved a better conceptual understanding of geometry content. In a study that investigated the effect of using GSP on students’ understanding of geometrical concepts, Author (2005) found a significant difference between the means of the scores on the posttest of students who used GSP and those who only

used the book in their geometry class. Also he found that students using the GSP performed significantly better than those using books only. He recommended the use of the GSP software on a regular basis in the classroom.

Bryk and Treisman (2010) indicated that “Recent studies report that between 60 and 70 percent of students placed into remedial math either do not successfully complete the sequence of required courses or avoid taking math altogether and therefore never graduate” (p. 19). They also indicated that some students in there sample did not pass math classes because they lost enjoyment and interest in learning math and they cannot see why they learn math which caused negative attitudes toward mathematics.

O’Donnell (2011) investigated if using Geometer’s Skecthpad as a teaching tool improves students’ attitudes towards Mathematics. The sample consisted of 31 high school geometry students who studies two units for eight weeks using only GSP. Students’ attitudes towards Mathematics were measure before the and after the study using a Modified Fennema-Sherman Attitude Survey, interviews, and the researcher’s journal. The results of both the interviews and the researcher journal notes indicated that students’ attitudes towards mathematics were improved. On the other hand, the results of the pre- and post- survey indicated no significant differences in the students’ attitudes towards mathematics which means there were no improvement.

Dekker (2011) investigated the effects of Geometer’s Sketchpad on student achievement and attitudes in algebra classrooms. The sample included 93 students in four classes enrolled in Advanced Algebra courses at Calvin Christian High School in Grandville, MI. They all participated in a five-day unit that explored graphs of equalities and inequalities. Two classes used traditional graphing calculators and two classes used Geometer’s Sketchpad. All four classes took an attitude survey at the end of the study. The results indicated that there were no significant differences in the students’ attitudes towards Mathematics.

Ramli (2015) conducted a study to determine the effectiveness of using the Geometer’s Sketchpad in the teaching –learning of Mathematics among technical schools’ students. The sample consisted of 56 students who were selected randomly from technical schools in Malaysia. The sample was divided into a controlled and an experimental group using cluster (class-based) random sampling. The students in the control group received conventional teaching method while the experimental group was taught using a GSP. All students in the sample were taught a unit of Trigonometric Functions for of 8 weeks. The results of that study indicated that the students in the sample showed positive attitudes and enthusiasm in learning mathematics using GSP.

Another study was conducted by Roble (2016) who investigated the effects on the junior high school students’ attitudes towards mathematics and technology. The students in the sample used the Geometer’s Sketchpad in their studying the Geometry lessons and activities. The results revealed that the students in the sample gained an increase positive attitudes towards mathematics and technology. These attitudes were influenced by the usage of the Geometer’s Sketchpad in the learning-teaching processes. These results also revealed recommendation from the researcher to mathematics teachers to use technological software such as Geometer’s Sketchpad in mathematics classes. This use will improve both students’ achievement in mathematics and their positive attitudes towards mathematics and technology.

The present study investigated the effect of using the computer software, the Geometer's Sketchpad (GSP), on the UAE Students' Attitudes towards Geometry. GSP is a dynamic construction and exploration tool that adds a powerful dimension to the study of mathematics. It is a tool for demonstrating and investigating geometric and algebraic problems in mathematics lessons. It can be used for guided investigation (where students use the software in small groups and are given an initial task to complete and then are challenged to do further exploration), open-ended investigation (where students use the software directly) and for teacher demonstration. By using Sketchpad to complete time-consuming mechanical tasks such as drawing circles and measuring their circumference, all

students will have more time to investigate the properties of the shapes such as the relationship between the length of the radius and the circumference. The results of this study might raise the importance and the effect of using technology, particularly interactive multimedia software, on teaching and learning mathematics.

2. THE STUDY

2.1. Participants

The population of the study consisted of 9th grade students in public schools in the city of Ain in UAE. The participants were selected randomly from an all-boy school and an all-girl school in the Al-Ain School Educational Zone during the Academic Year 2016/2017. The researcher randomly chose two 9th grade sections from each school. One section was the experimental group and the other section was the control group. The sample consisted of 98, 9th graders (46 female and 52 male students).

2.2. Research Question

This study aims at investigating the following question:

What is the effect of using an interactive software (GSP) on UAE students' attitudes towards Geometry?

2.3. Treatment

The researcher trained all the math teachers in both schools on how to use the GSP software in general. Then the math teachers of the four selected sections received more intensive training hours on how to teach the "circles" unit using this software. The teachers, in turn, trained their students on how to use the GSP software and provided them with all the words and expressions that are used in the menus of the GSP software. There were two research assistants; one math teacher in the male school and another math teacher in the female school. Those research assistants helped the researchers in preparing and implementing the training sessions including software installation and coordination of the training.

At the beginning of the study, all students in the experimental group completed a questionnaire that measures the attitudes towards geometry. The questionnaire was designed to give an idea of students' attitudes towards geometry prior to the start of the study. All the participants studied the "circles" unit, but only the experimental group used the GSP software, while the students in the control group did not. During the course of the study, students in the experimental groups went to the computer lab twice a week where they used the Geometer's Sketchpad for the duration of three weeks. In the lab, students completed activities designed to help them discover important geometric properties that relate to the unit of "circles". They answered questions that required them to critically think about the properties. Students, then, made conjectures based on the investigations and answers to the questions. At the end of the study, the sample students in the experimental groups completed the same attitude questionnaire.

3. RESULTS & ANALYSIS

Students in this study completed a four point Likert-scale questionnaire. Each of the four response choices was assigned a numerical value as follows: strongly disagree (1), disagree (2), agree (3) and strongly agree (4). Students' responses to the questionnaire were analyzed the responses on each item in the questionnaire.

The overall responses prior to implementation and following the implementation of the GSP were very similar. A few general conclusions can be made based on the data that was gathered. Based on the results it appears that students are more convinced of the veracity of a theorem when it is explored using a software the GSP. In addition,

students stated that this type of exploration is more convincing than a formal proof. It was also evident from the responses that students gain more enjoyment from lessons in the computer lab than traditional lessons that are more teacher-centered.

The students in the sample study showed generally positive attitudes towards Geometry. The mean of the responses of the sample students was 0.78. Here are some examples of students' perception on the use of GSP as a tool in mathematics:

- Now, the mathematics class is fun and interesting. GSP can make our learning in mathematics much more easier and interesting;
- I think using GSP is save a lot of time, faster and convenience;
- I think GSP has to use after the teacher taught the basic concepts, how to calculate x and $f(x)$ value to get coordinate and plot graph;
- Calculus became easier and more interesting,
- The GSP gave me a clearer picture of how the graphs of the derivative $f'(x)$ look like;
- I never use GSP before; it is quite difficult at the beginning. But now I like to draw mod before I solve the mathematics problem, I can animate the point and it help me a lot.
- With GSP, we were able to visualize the characteristics of the graphs such as when the graph is increasing or decreasing;
- Using GSP is very useful, I learn better and faster. Mathematics has become more fun an easy to learn;
- The activities made us do a lot of discovery and exploration, which were impossible without GSP. This made us discover the characteristics of the graphs of different functions, especially the complicated ones;
- The activities that go with it enabled us to work by pairs & group. Learning mathematic became easier;
- The answer from GSP sometimes may not be accurate. But it is not a problem at least I can see the model and the graph.
- It is easier when you see the graph on the screen. It just like answer the problem without
- so much energy used, you must know your work and know what you are doing;
- Learning mathematics has become more enjoyable and I learned a lot from the dragging and explorations;
- Complicated problems can be solved in an interesting way and can be understood better.
- Much quicker than doing the graph manually. I found it helpful; I can check my graph just in case I made a mistake;
- GSP helps you spend time understanding the mathematical reasoning of what you are doing. Instead of spending time trying to work out long mathematical computation.

The results of the current study are supported by the results of [Dekker \(2011\)](#); [Ramli \(2015\)](#) and [Roble \(2016\)](#).

Overall, the researcher concluded that the students in the sample liked using the GSP in learning Geometrical concepts such as the unit of "Circles". They showed positive attitudes and asked for using this software in teaching all lessons of Geometry.

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APPENDIX A

Students' Attitudes Questionnaire towards Geometry

1. Geometry is my favorite subject
2. I find Geometry to be harder than other math subjects I have taken.
3. I see the relevance of Geometry in everyday life.
4. I enjoy learning about Geometry.
5. I believe I could be more successful in this class if I had an opportunity to use technology such as GSP.
6. I found the geometry units to be easy.
7. I enjoy Geometry class.
8. It is important for me to learn about geometric concepts so that I will score well on tests.
9. It is not important for me to learn about geometric concepts.
10. I enjoy watching the teacher demonstrate concepts using Geometer's Sketchpad.
11. I enjoy using Geometer's Sketchpad.
12. GSP can make our learning in mathematics much easier and interesting.
13. I think using GSP saves a lot of time
14. I think using GSP makes learning faster and convenience.
15. I think GSP can be used after the teacher teaches the basic concepts.
16. GSP gave me a deeper and better understanding of the lessons because of the high-tech capabilities.
17. Using GSP is very useful, I learn better and faster.
18. The activities made us do a lot of discovery and exploration, which were impossible without GSP.
19. The activities that go with it enabled us to work by pairs & group.
20. The answer from GSP sometimes may not be accurate. But it is not a problem at least I can see the model and the graph.
21. Complicated problems can be solved in an interesting way and can be understood better using GSP.
22. Doing the graph using GSP much quicker than doing it manually.
23. GSP helps you spend time understanding the mathematical reasoning of what you are doing instead of spending time trying to work out long mathematical computation.
24. My teachers have been interested in my progress in geometry because of GSP.
25. I see the relevance of Geometry in everyday life.
26. I enjoyed the unit on circles using GSP.
27. I found the unit on circles to be easy using GSP.
28. Learning geometry using GSP has become more enjoyable and I learned a lot from the dragging and explorations.

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