Attitudes of male and female students to dynamic geometry computer software for learning mathematics

Folake M. Adelabu & Moses Makgato

Tshwane University of Technology
Soshanguve, South Africa

ABSTRACT: The attitude of male and female students to using dynamic geometry computer software was investigated for this study. Data collections were from 74 grade nine students from two secondary schools. The instrument by which data were collected was a Likert-type questionnaire containing 15 items. Analysis of the students' attitude was through percentages allocated to each item in the questionnaire. The results indicated that both male and female students have a positive attitude to employing dynamic geometry computer software. In addition, there is a positive correlation in their attitude towards dynamic software. The study findings are that dynamic geometry computer software and integration of technology into mathematics classrooms are beneficial to student learning.

INTRODUCTION

In the world today, technology is all pervasive: it is in our daily lives and all around us. Fields, such as medicine, engineering, transportation, and so on, are at ease with technology. Technological advances are rapid, providing new opportunities for mathematics education.

Mathematics, with other subjects, such as the sciences and technology, plays an important role in nation building; that is the reason the South African government attaches high value to both the teaching and learning of mathematics. To let students have a better understanding of mathematics, the government has tried to provide better learning environments by equipping schools with technology. With this new learning environment, Laborde [1], and Hohenwarter and Jones [2] opine that the use of technology improves students' understanding, and therefore they recommend a dynamic geometry environment for the teaching and learning of mathematical geometry [3].

Dynamic geometry computer software allows users to construct geometrical figures or shapes to measure the variables of the shapes and determine the properties of them. Examples of the dynamic geometry computer software include packages, such as Cabri Geometry, Geometers' Sketchpad, Cinderella and GeoGebra. Dynamic geometry computer software provides a non-traditional way of learning for the students [4]. The attitude of male and female students to the use of dynamic geometry computer software for learning mathematics was examined and is outlined in this article.

MALE AND FEMALE STUDENTS

Technology Usage

For the past 10 years, persistent gender differences have been observed in the use of computer technology. Studies have indicated that male students have an advantage over female students in the use of technology [5]. In the ability to use computers, females reported feeling helpless, nervous and uncomfortable around computers. In addition, males were rated higher than females in technological skills and ability [6]. Another study indicated that while most females tended to view technology as a tool, while males tended to view technology as a toy. Men try to compete and win, while women use the computer only to help them attain their goals [7].

Male students had a higher level of computer software usage than female students; and there was gender difference on the problems faced by students in the acquisition of skills and use of computers [8]. Compared with male students, females were claimed to be weak in the creation of concepts and in mappings and forming mental structures and guessing with regards to mathematical problems. However, the use of software and electronic procedures helps both

males and females in mathematics. The feedback was better among female students. The interest of female students in modern technologies may be another reason to attract them to these technologies [9].

Attitude to Learning Mathematics

Vale claims teachers believe that females *learn* mathematics, while males *know* mathematics [10]. He further explains that in learning goals females are disadvantaged in competitive environments. Though both males and females preferred a mathematics programme that enabled them to work at their own pace, their reasoning was different. Females valued experiences that allowed them to think and develop their own ideas; they were concerned with achieving understanding. Males, on the other hand, emphasised speed and accuracy, and saw these as indicators of success. Males' preferences enabled them to adapt to the competitive environment of a textbook-based mathematics learning environment [10]. According to Ramtu, in a study in which gender differences in mathematics class participation were examined, males' participation in mathematics class was better than that shown by the females [11].

Lee and Anderson concluded that females have the least positive attitude towards mathematics in a study on gender differences in mathematics attitudes in co-education and single-sex secondary education in Australia [12]. Several studies showed there was no significant difference between genders when it comes to the attitude towards mathematics [13][14]. In contrast, Kosgey et al concluded there did exist gender differences in attitude towards the learning of mathematics, but more study results favoured male students over female students [15]. The indication is that males have a higher positive attitude towards the learning of mathematics.

Attitude to Dynamic Geometry Computer Software

According to Forgasz, a study conducted in two schools in Australia indicated that males were more likely than females to believe that technology (computer software) use would improve their mathematical understanding [16]. The researcher also claimed that the effects of computer usage in lower grades are more likely to be advantageous to males' learning of mathematics. The effect is also beneficial to their attitude towards mathematics in the future. In other words, the implication of technology usage may be in the lower proportions of females studying mathematics at the higher-grade level and beyond, as compared with males.

According to Vale, attitudes to the use of technology (computers) for learning mathematics was more strongly interrelated with attitudes to technology (computers) than to mathematics, and this was more strongly the case for males than females [17]. The Barkatsas et al study investigated …*the complex relationship between the students' mathematics confidence; confidence with technology; attitude to learning mathematics with technology; affective engagement and behavioural engagement; achievement, gender and year level* [18].

Males with high mathematics achievements appear to be more confident in mathematics and in using technology (computers) than females do. In addition, males have a more positive attitude to learning mathematics with computers than females do. Bain and Rice also claim that there was no significant gender difference in the attitude to the use of computers; but female students do not have the same level of confidence as male students in using computers, therefore, gender does affect students' attitudes towards the use of technology [19].

Research studies showed gender differences in attitudes towards technology and also the use of technology in general, but there was limited research focusing on the attitudes of males and females towards the use of dynamic geometry software. Therefore, the aims of this study were to investigate the attitude of males and females in the use of dynamic geometry computer software for learning mathematics. The questions that guided the study were:

- Is there any difference between the attitudes of male and female students to the use of dynamic geometry computer software (DGCS) for learning mathematics?
- What is the correlation between the attitude of male and female students to the use of dynamic geometry computer software (DGCS) for learning mathematics?

METHODOLOGY

A quantitative approach was employed in the study, in which was featured a quasi-experimental research design. Therefore, the participants were not randomly selected.

Research Procedure

At the beginning of the study, students completed an attitude questionnaire. The questionnaire was designed to give the researcher an idea of student attitudes towards the use of dynamic geometry computer software before the start of the study. During the course of the study, students were taken to the computer laboratory. The computer laboratory had 25 computers. Each computer had a dynamic geometry computer software (DGCS) program installed. The intervention (use of DGCS) lasted for two weeks. While in the laboratory, the students completed activities designed to help them learn geometric properties of similar triangles and congruence.

Students were asked to answer various questions that required them to think critically about similarity and congruence. Students then made conjectures based on their learning. At the conclusion of the study, students filled out the same type of student attitude questionnaire that was completed at the beginning of the study. Reliability of the instrument was established by Cronbach's alpha coefficient, which was 0.7.

The selection of the 74 grade nine students was convenient and purposive; the students chosen were from two secondary schools in Tshwane South District, Gauteng province, which had available a computer laboratory. Twenty-eight of the participants were male, while 46 were female. Therefore, the sample was not randomly selected. The participants in this study completed an ethical consent form, where it was indicated that their participation was voluntary and all the information provided by the participants was kept anonymous.

The instrument employed in this study was a questionnaire designed to capture students' attitudes. The questionnaire was used to compare the attitude of males and females before and after the use of dynamic geometry computer software. The questionnaire comprised 15 items on a Likert scale of 1 - strongly disagree; 2 - disagree; 3 - unsure; 4 - agree; and 5 - strongly agree. The questionnaire consisted of statements that reflected the student's attitude to the use of DGCS. The questionnaire was reliable with $\alpha = 0.7$, which indicated it has good internal consistency.

RESULTS

Research question 1: is there any difference between the attitude of male and female students to the use of the DGCS for learning mathematics?

In Table 1, the results show the percentage differences of the attitude of male and female students towards the use of dynamic geometry computer software after the intervention.

Table 1: Attitude of male and female students towards the use of DGCS after the intervention.

Items	Statement	Response									
		Strongly agree		Agree		Unsure		Disagree		Strongly disagree	
		M (%)	F (%)	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)
1	I learn many things using dynamic geometry computer software	7 (25)	14 (30)	13 (46)	27 (59)	3 (11)	5 (11)	2 (0.7)	1 (0.2)	1 (0.4)	1 (0.2)
2	I enjoy learning mathematics using dynamic geometry computer software	7 (25)	17 (37)	14 (50)	22 (48)	4 (14)	3 (0.7)	0 (0)	4 (0.9)	1 (0.4)	2 (0.4)
3	I learn mathematics better when I am being taught by a teacher than computer software	8 (28)	18 (39)	7 (25)	18 (39)	2 (0.7)	4 (0.9)	3 (11)	5 (11)	6 (21)	3 (0.7)
4	Dynamic geometry computer software makes me think critically and creatively during learning	8 (28)	11 (24)	9 (32)	18 (39)	7 (25)	13 (28)	2 (0.7)	3 (0.7)	0 (0)	2 (0.4)
5	I gain better understanding of geometry using the computer software	11 (39)	15 (32)	9 (32)	16 (34)	2 (0.7)	12 (26)	4 (14)	4 (0.9)	0 (0)	1 (0.2)
6	I have difficulty with the dynamic geometry computer	3 (11)	4 (0.9)	2 (0.7)	8 (17)	4 (14)	5 (11)	9 (32)	15 (32)	8 (28)	16 (34)
7	I do not like using the computer software to learn mathematics	4 (14)	9 (20)	4 (14)	4 (0.9)	2 (0.7)	6 (13)	3 (11)	12 (26)	13 (46)	17 (36)
8	Using dynamic geometry software helps me to deal with my difficulty in learning	8 (28)	17 (36)	7 (25)	12 (26)	5 (18)	9 (20)	4 (14)	5 (11)	2 (0.7)	5 (11)
9	Using the computer software increases my interest in mathematics	15 (53)	18 (39)	8 (28)	21 (46)	3 (11)	3 (0.7)	0 (0)	4 (0.9)	0 (0)	2 (0.4)
10	I prefer to be taught by a teacher when it comes to geometry than the computer software	6 (21)	12 (26)	6 (21)	12 (26)	5 (18)	13 (28)	1 (0.4)	4 (0.9)	8 (28)	7 (15)
11	The use of the computer software improves my understanding of angles, congruency and similarity	13 (46)	15 (32)	6 (21)	17 (37)	4 (14)	11 (24)	2 (0.7)	4 (0.9)	1 (0.4)	1 (0.2)

	Statement	Response									
12	I gain a lot from my fellow students and the teacher during the interactive learning	5 (17)	15 (32)	9 (32)	15 (32)	8 (28)	11 (24)	2 (0.7)	5 (11)	2 (0.7)	2 (0.4)
13	Visualising and manipulating diagrams through the dynamic geometry computer software makes me know answers to the questions faster	9 (32)	9 (20)	10 (35)	23 (50)	4 (14)	8 (17)	3 (11)	6 (13)	0 (0)	2 (0.4)
14	I have confidence using the dynamic geometry computer software	9 (32)	16 (34)	9 (32)	19 (41)	5 (17)	6 (13)	2 (0.7)	5 (11)	1 (0.4)	2 (0.4)
15	I like dynamic geometry computer software for teaching and learning mathematics in our school	12 (42)	17 (37)	10 (35)	14 (30)	0 (0)	10 (21)	0 (0)	2 (0.4)	0 (0)	5 (11)

Description: M - male frequency; F - female frequency; % - percentage

Shown in Table 1 are the percentage differences between the attitude of male and female learners towards the use of dynamic geometry computer software after the intervention. The male and female results are close; that is, the percentage response of male and female students is nearly the same for each item, except for item three, where more female students than males preferred teachers to teach them mathematics.

Considering each item in the questionnaire, the percentage of male students strongly agreeing in items 4, 5, 9, 11 and 15 is higher than the percentage of female students:

- Dynamic geometry computer software makes me to think critically and creatively during the learning period (28%).
- I gain better understanding of geometry using the computer software (39%).
- Using the computer software increases my interest in mathematics (53%).
- The use of the computer software improves my understanding of angles, congruency and similarity (46%).
- I like dynamic geometry computer software for teaching and learning mathematics in our school (42%).

While 78% of female students strongly agree and agree with item 3: I learn mathematics better when I am being taught by a teacher than computer software.

The results indicate that both male and female students have a positive attitude towards the use of DGCS, nevertheless there were minor differences; more female students preferred to be taught by their teachers than did male students. Hence, to answer research question 1, the conclusion found there is a minor difference between the attitude of males and females towards the use of DGCS.

Research question 2: what is the correlation between the attitude of male and female students to the use of DGCS for learning mathematics?

In answer to research question 2, Figure 1 shows the overall means of male and female students' scores, before and after the use of DGCS.

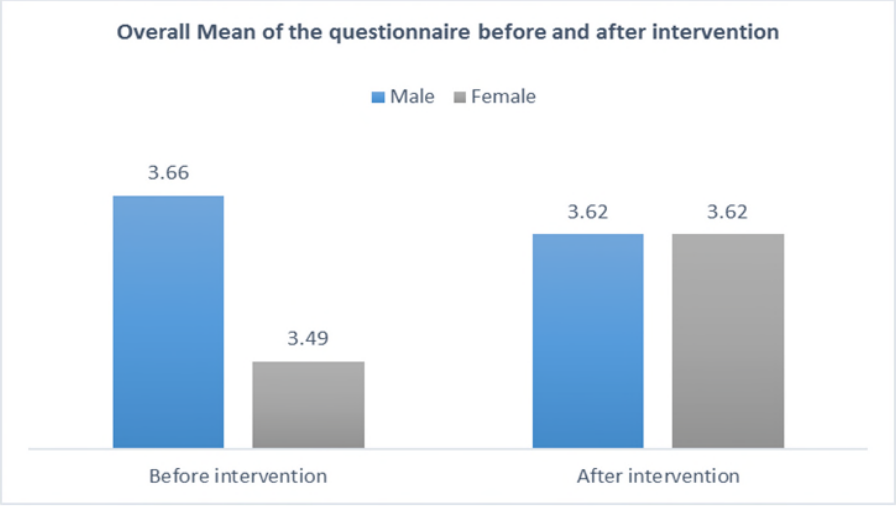

Figure 1: The overall mean of male and female students before and after the use of dynamic geometry computer software.

The results showed there was a slight difference in the overall mean scores of males and females before the use of DGCS. The difference in the overall mean score is 0.17. Male and female students have the same mean score after the use of DGCS.

Correlation coefficients between the male and female students before and after intervention were 0.95 and 0.89, respectively. This indicates a positive correlation of attitude between male and female students in the use of DGCS. That is, both student groups had a positive correlation attitude to the use of DGCS. In summary, the results indicated that both male and female students had a positive attitude towards the use of DGCS. In addition, there is a positive correlation attitude between male and female students in willingness to use dynamic geometry computer software.

CONCLUSIONS

The aim of the study was to investigate the attitude of male and female students towards the use of dynamic geometry computer software. The results showed that there was a minor difference in the attitude of males and females towards the use of DGCS; nevertheless, both have a positive attitude to the use of DGCS. In this regard, the conclusion was that male and female students have a positive attitude towards the use of dynamic geometry computer software.

In addition, it was revealed that there is a positive correlation between male and female students in willingness to use dynamic geometry computer software. The results were that both recorded the same overall mean scores after the intervention.

Therefore, both student groups had the same positive attitude. This study is not in agreement with other studies on gender difference towards DGCS and technology in general that found male students have a positive attitude towards computer software, as compared to female students [5][6][8][9][15]. On the other hand, the study is in agreement with Bain and Rice, where female students have the same level of confidence as male students in using computers; therefore, gender did not affect their attitude towards the use of DGCS [19].

Both male and female students found the software was helpful and could improve their knowledge and skills. Therefore, to promote and encourage students' attitudes towards mathematics regardless of gender, integration of technology in the mathematics classroom is important. The findings of this study are that the use of dynamic geometry computer software and integration of technology in the mathematics classroom is beneficial to student learning.

REFERENCES

1. Laborde, C. Integration of technology in the design of geometry tasks with Cabri-Geometry. *Inter. J. of Computers for Mathematical Learning*, 6, **3**, 283-317 (2001).
2. Hohenwarter, M. and Jones, K., Ways of linking geometry and algebra: the case of geogebra. *Proc. British Society for Research into Learning Mathematics*, 27, **3**, 126-131(2007).
3. Ding, L. and Jones, K., Teaching geometry in lower secondary school in Shangal, China. *Proc. British Society for Research into Learning Mathematics* (2006).
4. Guven, B. and Kosa, T., The effect of dynamic geometry software on student mathematics teachers' spatial visualization skills. *The Turkish Online J. of Educational Technol.* (2008).
5. Bartler, K.M. and Aspray, W., *The Transition of Women from the Academic World to the IT Workplace: a Review of Relevant Research*. In: Cohoon, J.M. and Aspray, W. (Eds), Women and Information Technology. Research on Underrepresentation. Cambridge: The MIT Press (2006).
6. Wong, S.L. and Hanafi, A., Gender differences in attitudes towards information technology among Malaysian student teachers: a case study at University Putra Malaysia. *Educational Technol. & Society*, 10, **2**, 158-169 (2007).
7. Eck, J., Hale, M., Ruff, S. and Tjelmeland, M., *An Educator's Guide to Access Issues* (2002).
8. Alakpodia, O.N., Gender differences in computer use skill among students of school of health technology, ufuoma, delta state. *Inter. J. of Digital Library Services*, 4, **4**, 1-11 (2014).
9. Fatemi, S., Rostamy-Malkhalifeh, M., Behzadi, M.H., The examining effect of gender factor on learning mathematical concepts via instructional software. *Mathematics Educ. Trends and Research*, 8 (2012).
10. Vale, C., Females back off mathematics again: the views and experiences of females in computer-based mathematics. *Mathematics Educ. Research J.*, 14, **3**, 202-218 (2002).
11. Ramtu S.A., An Investigation of Gender Differences in Mathematics Class Participation: a Case Study of Early Primary Students in Mombasa-Kenya. The Aga Khan University Tanzania Institute for Higher Education Institute for Educational Development, Eastern Africa (2014)
12. Lee, K. and Anderson, J., Gender differences in mathematics attitudes in coeducational and single sex secondary education. Mathematics education in the margins. *Proc. 38th Annual Conf. of the Mathematics Educ. Research Group of Australasia*, Sunshine Coast: MERGA, 357-364 (2015).
13. Karjanto, N., Attitude toward mathematics among the students at Nazarbayev University Foundation Year Programme. *Inter. J. of Mathematical Educ. in Science and Technol.*, 48, **6**, 849-863 (2017).
14. Larbi, E. and Okyere, M., Algebra tiles manipulative and gender differences in learning and achievement in Mathematics: a case of Sunyani West Municipality. *J. of Educ. and Practice*, 5, **38** (2014).

15. Kosgey, A.K., Manduku, J.G. and Bii, J., Gender Differences and Attitudes Towards Learning of Mathematics among Secondary School Students in Keiyo District, Kenya (2015), 14 June 2019, https://su-plus.strathmore.edu
16. Forgasz, H.J., Are females disadvantaged by the use of calculators and computers for mathematics learning? *Electronic J. of Mathematics & Technol.*, 3, **3**, 285-300 (2009).
17. Vale, C., Gender and Socio-economic Issues in the use of Digital Technologies in Mathematics. Victoria University, Australia (2005).
18. Barkatsas, A.N., Gialamas, V. and Kasimatis, K., Secondary Students' Attitudes to Learning Mathematics with Technology: Exploring the Interrelationship Between Gender, Engagement, Confidence and Achievement. Monash University, Australia; University of Athens, Greece; Pedagogical Institute of Greece (2008).
19. Bain, C.D. and Rice, M.L., The Influence of gender on attitudes, perceptions, and uses of technology. *J. of Research on Technol. in Educ.*, 39, **2**, 119-132 (2006).