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The Effect of GeoGebra Classic 6 Software on First-Year Students' Graphing Skills of Hyperbola Functions and Confidence in Lusaka District

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ABSTRACT: This study investigated the effect of GeoGebra Software Classic 6 on first-year students' graphing skills of Hyperbola Functions and confidence in Lusaka district. Quasi-experimental was used in the study, that is, pre-test post-test control group design. The research sample consisted of two first-year students lecture groups. The study comprised an experimental group (n=25) and a control group (n=25) first-year students studying MAT 101 (Foundation Mathematics) at one institution in Lusaka district. First-year students in the experimental group were taught using GeoGebra Software Classic 6 and those in the control group were taught using traditional teaching methods. A Hyperbola Function Achievement Test (HFAT) and a 5-point Likert Scale confidence questionnaire was used to assess the effect of GeoGebra Software Classic 6 on First-year students' confidence on how to graph Hyperbolic Functions. An independent samples t-test was used to compare academic achievement of the two groups at 95% confidence level. Confidence in handling Hyperbolic Functions was analysed using descriptive statistics (mean). The findings showed that GeoGebra Software Classic 6 had a positive effect on first-year students' graphing skills in Hyperbolic Functions $(df = 48,\ p - value = .000, t = 8.422, \alpha = 0.05)$. The study also revealed that GeoGebra Software Classic 6 allowed male and female First-year students to learn how to graph Hyperbolic Functions at the same level and this led to a conclusion that GeoGebra Software Classic 6 is not discriminatory and effects positively on gender. The confidence results indicated that first-year students' confidence on how to graph Hyperbolic Functions was enhanced more in the experimental group compared to the control group with confidence mean of $7.67\,(SD = 2.45)$ and $6.19\,(SD = 4.05)$ respectively. In view of these findings, lecturers of mathematics are advised to utilize the graphing application GeoGebra Software Classic 6 in their lecture theatres. Additionally, lecturers of mathematics in Higher Learning of Institutions should be encouraged to use GeoGebra Software Classic 6 in the teaching of how to graph Hyperbolic, Parabola, and Ellipse Functions.

KEY WORDS: Confidence, GeoGebra Software Classic 6**,** Graphing skills, Hyperbola Functions

INTRODUCTION

Technology is considered a new element in the structure of education in the last three decades. The use of technology has increased in classrooms as a supporting tool in the teaching and learning process (Cubukcuoglu, 2013). The role of technology goes beyond only using machines, devices and software to the effect it could have on all elements of education, for example, lecturers and students or teachers and learners, curriculum with its wide definition, teaching methods, assessment and the whole community in a broader view. It is obvious that technology has a positive role in raising the efficiency of the educational process by solving a lot of educational problems such as the knowledge flow, the revolution of information explosion, the increasing number of learners, and the individual differences between students (Ogbonnaya, 2010). In addition, educators claim that it improves the achievement of students, for example Muir-Herzig (2004) stated that, the use of technology in education enhances students' learning and helps the educators to encourage a constructivist class environment. Furthermore, many studies such as that of Lester (2013) have shown that the retention rate of students for knowledge, mastering higher order thinking skills, and adopting positive attitudes and a greater motivation for the future learning in the traditional learning is limited, while in active learning integrated with modern technologies, the survival rate of information is much higher.

Technology in education today includes digital learning tools, which varies from one institution to another. The technological tools, such as computers, mobile devices, calculators, open resources, software, platforms, digital books, and internet. are all examples of technology used currently in the teaching and learning settings (Zulu, Nalube, Changwe & Mbewe, 2021). Technology, as many educators suggest, increases the engagement of students in the learning process, motivates them to learn faster and serves the idea of student-centered learning (Darling-Hammond, Zielezinski & Goldman, 2014). Technology has a significant role in online learning, it helps in keeping students and lecturers get connected all the time which adds more productivity to this process. The new generation of learners are heavily dependent on technology in their lives, which shows the need of using technology in their learning to improve the quality of education. Modern technology can offer many means of improving teaching and learning in the classroom (Lefebvre, Deaudelin & Loiselle, 2006).

Technology is closely related to teaching and learning of mathematics. The importance of using technology in learning mathematics is widely acknowledged. To excel well in mathematics, high level of cognitive processes such as critical thinking, reasoning and imagination are required (Rajagopal, Ismail, Ali & Sulaiman, 2015). As a result, new teaching or learning approaches should be considered when mathematics is learnt "Mathematics should be approached with different types of learning methods where students can enhance their understanding and make the learning fun (Zulu, Nalube, Changwe & Mbewe, 2021). Therefore, old traditional ways of teaching and learning must be changed to meet the needs of a revolutionized education, to let students see and feel the real beauty of mathematics and to develop a deep understanding of mathematics concepts (Zulu, Nachiyunde, Nalube & Masaiti, 2021).

This is clearly emphasized by the National Council of Teachers of Mathematics (NCTM), which highlights the important role of technology "technology is essential in teaching and learning mathematics; it influences the mathematics taught as well as enhances student's learning" (NCTM, 2000, p. 24). The NCTM underlines the significance of using the suitable technology to build a deep understanding of mathematics, which should take students to a greater level of constructing higher logical skills, like critical thinking, decision-making, reflection, reasoning, and problem solving. Integration of Technology in mathematics classrooms is essential to ensure that students can learn whatever they want in the best ways. Appropriate learning approaches enriched with the suitable technology tools could take the learning process from only transferring knowledge to the level of constructing the knowledge and relate it to students' experience as stated by Zengin and Tatar (2017).

Zambian Government through the Ministry of Education (MoE) in 2013 introduced the use of Information and Communication Technologies (ICTs) in the school curriculum. The National Curriculum Framework of 2013 states that government will encourage: the use of ICTs in schools, colleges, universities and other educational institutions in the country so as to improve the quality of teaching and learning (Ministry of Education, Science, Vocational Training and Early Education (MESVTEE), 2013). Nevertheless, the newly-introduced ICTs subject in Zambian schools provides strong evidence that policymakers in the country‘s education sector have recognized the importance and value of technology for learning and teaching in schools, colleges, and universities. Additionally, it is indisputable that the ICTs is increasingly becoming important in achieving development goals and promoting citizen participation not only in Zambia but across borders. Using digital technology when and where appropriate would help students to study all relations in transformations such as translations, reflections and stretches of all graphs.

During the past few decades, there has been a great evolution in mathematical software packages. Among the great amount of software, there are two important forms of software contributing to the teaching and learning of mathematics: Computer Algebra Systems (CAS) and interactive or Dynamic Geometry Systems (DGS). These two tools have had a significant influence on mathematics education. However, these are not connected to each other at all. Fortunately, there is a software system called GeoGebra that integrates possibilities of both dynamic geometry and computer algebra in one program for mathematics teaching (Hohenwarter & Jones, 2007). GeoGebra is a dynamic mathematics' software for all levels of education that brings together Geometry, Algebra, Spreadsheets, Graphing, Statistics and Calculus in one easy-to-use package. GeoGebra is an open-source software program created by Markus Hohenwarter in 2001(Zengin, Furkan & Kutluca, 2012).

GeoGebra Software is an interactive mathematics program for teaching and learning mathematics from elementary to university level. The shapes can be constructed by means of a mouse, touch screen or input bar using commands. The elements can also be animated by moving them and used to illustrate or prove mathematical and engineering theories (Lester, 2013). The philosophy of the software is based on a strong conviction and deep belief that every student can learn mathematics if given the opportunity to learn, and solve problems of a level appropriate to his/her abilities as quickly as possible. The software is based on a scientific concept that depends on learning by doing. Mathematics requires a lot of practice to master its skills and to understand its concepts and to link these skills and concepts. Therefore, providing sufficient opportunities for practice makes student learning of mathematics possible. And then, gradually the student can move to more difficult issues or mathematics problems after he or she has mastered the previous concepts needed to solve them. Thus, the awe of mathematics and lack of confidence in the ability to learn it gradually disappears (Mohamed & Guandasami, 2014).

Students in universities begin to come across higher levels of mathematics, they are introduced to new concepts that aim to increase students' abilities of solving real-life problems. In algebra courses, the concept of the Hyperbola, Parabola and Ellipse Functions is a perfect example where first-year students could connect mathematics and model the real world. The NCTM (2000) states that students need to "learn to use a wide range of explicitly and recursively defined functions to model the world around them. Moreover, their understanding of the properties of those functions will give them insights into the phenomena being modeled" (p. 288).

Algebra courses in universities should assist students to "come to understand the concept of a class of functions and learn to recognize the characteristics of various classes" (NCTM, 2000, p. 297). Therefore, it is important for all students to comprehend that Hyperbolic Functions share the same characteristics, then they can move on easily to learn other functions such as Parabola and Ellipse Functions. Furthermore, understanding Hyperbola Functions would make it easier for students to learn other types of Hyperbola functions and graphing transformations. Unfortunately, students face a lot of difficulties and develop misconceptions when they learn Hyperbola Functions and their transformations, which may influence their achievements as number of researches have revealed as mentioned in the study of (Zengin & Tatar, 2017).

Zengin and Tatar (2017) further pointed out that understanding Hyperbolic Functions requires the ability to build a solid relationship between the abstract, visual and concrete representations of mathematical objects, and students are particularly handicapped by their inability to formulate and transpose algebraic expressions. In addition, the subject is confounded by interrelationships between functions (Ross, Bruce & Sibbald, 2011). GeoGebra Software provides tools for graphical, numerical and algebraic representations of mathematical objects on the same interface. Therefore, different representations of the same object are assembled dynamically and any change in one of these representations is automatically transformed to the other ones (Kepceoğlu & Yavuz, 2016).

Although many studies had been conducted all over the world investigating the influence of technology to support learning of different concepts in mathematics, few changes are seen in the schools' curriculum to integrate more technology in classes despite the fact that most of these studies revealed the positive correlation between the use of technology and students' achievements. In addition, studies examining the effect GeoGebra Software Classic 6 on First-Year students' graphing skills in Hyperbola Functions are limited. This study aims to assess the effect of teaching using GeoGebra Software Classic 6 on First-Year students' graphing skills in Hyperbola Functions. The study also aims to determine the difference between the achievement of male and female First-Year students taught using GeoGebra Software Classic 6 in Hyperbola Functions. Additionally, the study sought to assess the effect of teaching using GeoGebra Software Classic 6 on First-Year students' confidence in handling Hyperbola Functions problems.

METHODOLOGY

This part presents the research methodology employed in the study. It encompasses, the research design, research approach, location of the study, sample size and sampling procedure, data collection instrument and procedure, validity and reliability, and data analysis.

RESEARCH DESIGN

The research design is a plan for studying the research problem that specifies the type of data, the methods to be employed to collect them, and how the collected data will be analysed (Thomas, 2009). This research study used a quasi-experimental research design. The students were divided into two groups: *Experimental group:* it contained first-year students who were taught how to graph Hyperbolic Functions using GeoGebra Software Classic 6 (N= 25). *Control group:* It contained first-year students who were taught how to graph Hyperbolic Functions by using regular teaching methods (N=25). A diagnostic test was administered before the beginning of the study to ensure that first-year students had the same level of mathematical knowledge and the background. A pre-test was given to the two groups to test the equivalency between the two groups before starting the study. After four weeks, a post-test was given to the two groups, in order to compare the achievements of the two groups after the implementation of the GeoGebra Software Classic 6.

RESEARCH APPROACH

Research approach refers to the fundamental set of principles and general procedural guidelines. Approaches are road maps that are associated with research purposes or scientific interests (Creswell, 2012). The researchers employed quantitative approach in achieving the research objectives. In this context, the researcher used the quantitative process to allocate meaningful numerical values to qualitative data, and they qualitatively analysed and assigned meaning to quantitative data (Cohen, Manion & Morrison, 2004).

LOCATION OF THE STUDY

This study was conducted in Lusaka district of Lusaka Province. In line with Zulu and Nalube (2019), there are many motivating factors that could influence the researcher's choice of the study site, such as; the nature and incidence of the problem, research time frame, and data accessibility, clients' interest and instructions, availability of resources, performance in a particular field, goals and objectives of the study. Therefore, the researchers selected Lusaka district of Lusaka Province, as the choice of the site for the study because it has appeared that a study on the effect of GeoGebra Classic 6 Software on first-year students' graphing skills of Hyperbola Functions and Confidence in Lusaka district, has not been conducted at the time of this present study; as such the knowledge gap for Lusaka district of Lusaka Province, Zambia clearly appears to have existed. Additionally, poor graphing skills among the first-year in Hyperbolic Functions necessitated the authors to assess the effect of GeoGebra Classic 6 Software on first-year students' graphing skills of Hyperbola Functions and Confidence in Lusaka district.

Sample Size and Sampling procedure

Fifty first-year university students participated in this study and 25 of them were female and 25 of them were male students. To accommodate the gender differences, two males and two females sections were chosen. The classes were selected using cluster sampling strategy. After the two classes were selected, one class was selected randomly to be the control group while the other one class was the experimental group. The experimental and the control group, each included a male and a female section.

DATA COLLECTION INSTRUMENTS

Hyperbola Function Achievement Test (HFAT)

Much of the quantitative data was collected through the statistical achievement test. Validation of this instrument was guaranteed because the researchers adapted statistical tests already tested for validity. To assess First-Years graphing skills in Hyperbola functions, a Hyperbola Function Achievement Test (HFAT) was administered. The HFAT was made up of the pre-test and post-test for both control group and experimental group. To prepare the HFAT, questions were derived from the past examination past papers from institution X.

Confidence Questionnaire

A 5-point Likert scale confidence questionnaire, ranging from strongly disagree (1) to strongly agree (5) developed by the researcher was used to collect data which was used to assess the effect of GeoGebra Classic 6 Software on first-year students' graphing skills of Hyperbola Functions and Confidence. It was administered as pre-test and post-test to both experimental group and control group. The questionnaire consisted of 3 statements (items):

(1) $4x^2 - 9y^2 = 36$

(2) $25y^2 - 4x^2 = 225$

(3) $\frac{x^2}{16} - \frac{y^2}{4} = 1$

INSTRUMENT VALIDITY

Hyperbola Function Achievement Test (HFAT)

Face and content validity for a Hyperbola Function Achievement Test (HFAT) was done by the researchers at the University of Zambia. This was done in order to make sure that the test had appropriate content and measured what it was intended to measure. The (HFAT) was piloted on First-Year students at a nearby institution. This allowed for detection of weaknesses in the test items and corrected accordingly before the final form was prepared for administration.

Confidence Questionnaire

Face and content validity of confidence questionnaire was done by the researchers. This was done in order to see if content was appropriate and measured what it was intended to measure. It was pilot tested at institution X.

INSTRUMENT RELIABILITY

Hyperbola Function Achievement Test (HFAT)

Reliability of a Hyperbola Function Achievement Test (HFAT) instrument was determined using Test-retest method of six weeks interval. The test scores that were obtained from the first and second administration was correlated using Pearson product moment correlation coefficient. With high index ($r = 0.80$) obtained, the instrument was declared reliable.

Confidence Questionnaire

The internal consistency of the confidence questionnaire was tested using Cronbach alpha and all the items appeared to be worthy of retention. With $\alpha \geq 0.9$ obtained, the instrument was declared reliable.

DATA COLLECTION PROCEDURE

Pre-Study

The researcher downloaded GeoGebra Software Classic 6 in advance and installed it on the institutional computers in the computer laboratory.

Experimental Group

Students in the experimental group were introduced to GeoGebra Software Classic 6 before the beginning of the intervention for the purposes of familiarizing them with the software. This orientation took three (3) hours on the first day and the other two (2) hours on the second day. The first-year students liked the GeoGebra Software Classic 6 because of its user-friendly interface. During lessons in the experimental group, the first-year students were able to identify the vertex, the center, foci and vertices; the length of the transverse and conjugate axes; the eccentricity; the equations of the directrices and asymptotes; sketch and were able to determine the solutions of a Hyperbola Function using the graph of the related function using GeoGebra Software Classic 6.

Control Group

The control group was taught using traditional lecturing method. The content that was taught in the control group was exactly the same as that which was taught in the experimental group. All questions and tasks were the same for the two groups; the only difference was the methodologies used. Experimental group was taught with GeoGebra Software Classic 6 while the control group was taught using traditional lecturing methods without GeoGebra Software Classic 6. In the control group, first-year students primarily learnt by listening, observing, and discussions in small groups and as a whole class whenever question and answer strategy was employed in the teaching. Each lesson was 3 hours long and teaching was done for one month.

Data Analysis

Analysis of quantitative data from the test started with computation of test scores which were later analyzed by both inferential and descriptive means (Collins & Stockton, 2018). The data that was collected was analyzed using statistical package for social sciences (SPSS) version 26 (IBM, 2021). The independent samples t-test was used to check if there were statistically significant differences in the academic achievement mean scores between the experimental group and the control group. Data that was collected using a five-point Likert Scale confidence questionnaire was analysed using descriptive statistics (mean) and results were presented in form of tables for easy description of trends in the data. The level of significance for acceptance or rejection of null hypotheses was set at $\alpha = 0.05$, confidence level = 95%.

Findings

What is the effect of teaching using GeoGebra Software Classic 6 on First-Year students' graphing skills of Hyperbola Functions?

In order to check equivalency of the control and experimental groups in terms of knowledge, a Hyperbola Function Achievement Test (HFAT) developed by the researchers was given to the respondents before the intervention as a pre-test.

Pres-test results

Table 1: Independent samples t-test

Equal Variance Assumed	Group	N	Mean	Mean Diff	SD	t	df	Sig (2 tailed)
	Experimental	25	40.00	-1.4400	13.80	-.359	48	.722
	Control	25	41.44		14.59			

Source: Field data, 2021

Table 1 shows the independent samples t-test results for the pre-test scores for the control and experimental groups. The t-value was -.359 for 48 degrees of freedom and the probability value was .722. The probability value calculated is greater than the set α-level equal to 0.05. This simply means that there is no statistically significant difference in knowledge on first-year students graphing skills of Hyperbolic Functions between the control group and the experimental group. This showed that the two groups were equivalent in terms of knowledge they had on graphing of Hyperbolic Functions before the intervention. Another possible factor that led to such results in this domain is the type of questions first-year students are exposed to in their classes on a daily basis. Each time the researcher wrote a Hyperbola Function in the vertex form with the control group, he asked students to mention the characteristics of this function and graph the function on the board.

Post-test results

Table 2: Independent samples t-test

Equal Variance Assumed	Group	N	Mean	Mean Diff	SD	t	df	Sig (2 tailed)
	Experimental	25	80.28	34.92	12.18	8.42	48	.000
	Control	25	45.36		16.79			

Source: Field data, 2021

Table 2 shows the independent samples t-test results for the post-test scores for the control group and experimental group. The t-value was 8.42 for 48 degrees of freedom and p-value was .000. The p-value calculated is less than the level of significance α-level = 0.05. This means that there is a statistically significant differences in the post-test achievement mean scores between control group taught using traditional method of teaching without GeoGebra Software Classic 6 and experimental group taught using GeoGebra Software Classic 6. This means that GeoGebra software had a positive effect on first-year students' graphing skills in Hyperbolic Functions as compared to traditional method without GeoGebra software Classic 6.

What is the difference between the achievement of male and female first-year students taught using GeoGebra Software Classic 6 in Hyperbolic Functions?

Pre-test results

Table 3: Independent samples t-test

Equal Variance Assumed	Group	N	Mean	Mean Diff	SD	t	df	Sig (2 tailed)
	Experimental	25	43.56	-.600	13.91	-.131	48	.896
	Control	25	44.16		18.10			

Source: Field data, 2021

Table 3 shows an independent samples t-test results for pre-test for the male and female first-year students. The t-value was -1.131 for 48 degrees of freedom, p-value was 0.896. This p-value is greater than the level of significance $\alpha = 0.05$, meaning that there is no statistically significant difference in graphing Hyperbolic Functions between male and female first-year students in the experimental group and control group. This showed that the male and female first-year students were at the same level in terms of graphing Hyperbolic Functions before the intervention.

Post-test results

Table 4: Independent samples t-test

Equal Variance Assumed	Group	N	Mean	Mean Diff	SD	t	df	Sig (2 tailed)
	Experimental	25	55.36	1.12	15.98	.226	48	.822
	Control	25	54.24		18.99			

Source: Field data, 2021

Table 4 shows the independent samples t-test for post-test scores for male and female first-year students in the experimental group and control group. The t-value was .226 for 48 degrees of freedom and the p-value was .822. This p-value is greater than the level of significance $\alpha = 0.05$ (p$>$ 0.05). Therefore, this means that there was no statistically significant difference in the post-test graphing skills mean scores between male and female first-year students in the experimental group and control group. This means that GeoGebra Software Classic 6 had no effect on gender.

What is the effect of GeoGebra Software Classic 6 on First-Year Students' Confidence in Graphing Hyperbolic Functions?

The confidence of first-year students in Hyperbolic graphing skills was investigated by using a questionnaire developed by the researcher with five (5) point Likert scale ranging from strongly disagree (1) to strongly agree (5) as a data collection instrument. The questionnaire was given as both pre and post-test.

Pre-test Confidence Results

The confidence questionnaire was administered before treatment in order to determine the initial first-year students' confidence on how to graph Hyperbolic Functions in the experimental and control groups. The responses from the pre-test questionnaire were analyzed and outcomes summarized in Table 5 and 6. The confidence mean and standard deviation were calculated in order to show the mean for first-year students' confidence on the five-point Likert scale. A mean score of above 5.0 meant a positive confidence (high confidence) on how to graph Hyperbolic Functions, a mean score of 5.0 meant neutral (not decided) and a mean score of below 5.0 meant negative confidence (low confidence) on how to graph Hyperbolic Functions. The following are the column heading codes: SD – Strongly Disagree, D – Disagree, N – Neutral, A – Agree, SA – Strongly Agree, CM – Confidence Mean, STD.D – Standard Deviation.

Table 5: Pre-test Confidence Results

Group	SD (%)	D (%)	N (%)	A (%)	SA (%)	CM	STD. D
Experimental	**14.23**	**21.34**	**23.12**	**18.34**	**8.23**	**4.15**	**2.123**
Control	**10.76**	**20.14**	**16.56**	**24.34**	**2.67**	**3.82**	**1.424**

Source: Field data, 2021

Table 5 shows that the two groups were comparable in terms of their confidence on how to graph Hyperbolic Functions as seen from confidence mean (CM) responses of 4.15 $_{\text{Experimental}}$ and 3.82 $_{\text{Control}}$, which on the 5-point Likert scale both groups had negative motivation on how to graph Hyperbolic Functions. The confidence questionnaire was administered after treatment in order to assess the effect of GeoGebra Classic 6 Software on first-year students' confidence on how to graph Hyperbolic Functions. The post-test questionnaire responses were analyzed in the similar manner as in the pre-test and the results were summarized and presented in Table 6.

Post-test Confidence Results

Table 6: Post-test Confidence Result

The following are the column heading codes: SD – Strongly Disagree, D – Disagree, N – Neutral, A – Agree, SA – Strongly Agree, CM – Confidence Mean, STD.D – Standard Deviation.

Group	SD (%)	D (%)	N (%)	A (%)	SA (%)	CM	STD. D
Experimental	**2.45**	**15.13**	**16.76**	**23.14**	**20.14**	**7.67**	**1.45**
Control	**4.05**	**12.13**	**21.60**	**28.78**	**18.17**	**6.19**	**2.16**

Source: Field data, 2021

Table 6 shows that the two groups were different in terms of their confidence on how to graph Hyperbolic Functions as seen from confidence mean (CM) responses of 7.67 $_{\text{Experimental}}$ and 6.19 $_{\text{Control}}$, which on the 5-point Likert scale meant positive confidence on how to graph Hyperbolic Functions.

DISCUSSION OF THE RESULTS

Effect of GeoGebra on First-Year Students' Graphing skills in Hyperbolic Functions

The findings of this research study revealed that there was statistically significant differences in the academic achievement mean score of the post Hyperbolic Functions test results of first-year students in the experimental group which was taught with GeoGebra Software Classic 6. When the average scores in the Hyperbola Function Achievement Test (HFAT) instrument were compared using an independent samples t-test, it was revealed that there was a statistically significant difference between the mean academic achievement score of the experimental group, which was taught with GeoGebra Software Classic 6 and that of the control group, which was taught using traditional methods without GeoGebra Software Classic 6. Therefore, results of the study revealed that GeoGebra Software Classic 6 had a positive effect on first-year students' graphing skills in Hyperbolic Functions.

Table 2 shows an independent samples t-test of Hyperbolic Functions Achievement post-test $(df = 48,\ p - value = .000, t = 8.422, \alpha = 0.05)$ under two tailed. Since the p-value is less than $\alpha = 0.05$, results of the study established that there was a statistically significant difference in the Hyperbolic Functions Achievement mean score of first-year students in the post-test results for the experimental group taught with GeoGebra Software Classic 6 and control group taught without GeoGebra Software Classic 6. The result shows that GeoGebra Software Classic 6 had positive effect on first-year students' graphing skills in Hyperbolic Functions.

This difference in Hyperbolic Functions Achievement post-test between experimental and control groups (in favour of experimental group) is as a result of the use of GeoGebra Software Classic 6 which facilitated easier understanding of Hyperbolic functions concepts in the experimental group. These results also show that GeoGebra Software Classic 6 allowed learners to participate actively in their learning; hence the concepts of Hyperbolic functions were understood better.

The findings of this study are in line with the study conducted by Pfeiffer (2017) who found that GeoGebra presented an excellent opportunity to better understanding of functions transformation; students demonstrated a deep abstract conceptual understanding when moving forward in learning new functions and graphs. The findings of the study are also supported by Shadaan and Leong (2013) who looked at the effectiveness of using GeoGebra Software Classic 6 on students' understanding in learning circles. Results of the study showed that not only student scores were increased, but GeoGebra Software Classic 6 created an energetic classroom environment that was full of clear values of cooperation and collaboration among students.

In view of the above findings, researchers therefore argue that GeoGebra Software Classic 6 had a positive impact on first-year students' graphing skills in Hyperbolic functions. The possible reasons for this finding could be that GeoGebra Software Classic 6 enabled students in the experimental group to check the correctness of their methods, the accuracy of their work, and immediate feedback was obtained. Being able to check one's own work goes a long way in determining achievement levels in general and in particular graphing skills. Because GeoGebra Software Classic 6 is dynamic, students in the experimental group had opportunities of re-examining their work and see how changing any parameter could affect the graph, while those in the control group could not do the same. In the control group, teaching was limited to a few examples, because drawing many graphs on the whiteboard consumed both time and space.

In addition, the production of good-quality sketches requires competence in technical drawing skills, which not all students possess. GeoGebra Software Classic 6 generated sketches which were neat and accurate and reflected the characteristics of Hyperbolic functions; it allowed students in the experimental group real-time exploration opportunities. Consequently, this improved the learning process in terms of speed and quality (Ljajko & Ibro, 2013).

The first-year students revealed that their drawings improved from that of using dots, that is, from using a calculator (which is quite laborious) to free sketching using knowledge acquired from the use of GeoGebra Software Classic 6. The first-year students' responses coincide with Naidoo and Govender's (2014) findings that GeoGebra Software Classic 6 aids the element of visualisation that plays an important role in the learners' exploration of trigonometric functions graphs. Unlike the calculator, GeoGebra enabled first-year students to project several graphs (in varying colours) during worksheet activities, and relate them to the mother graph and this saw them being able to sketch without table values from a calculator. Comparing all the graphs drawn by participants before and after interacting with GeoGebra Software Classic 6, shows that the tool enabled first-year students to draw graphs from abstraction. In fact, Van Woudenberg (2017) found that GeoGebra is a better tool to replace a calculator in the learning of some mathematics concept like those in trigonometric functions.

Stiff (2001) noted that students in constructivist learning environments can deepen their understanding by constructing or building new knowledge on prior knowledge or experiences. During the focus-group discussions, first-year students revealed that GeoGebra Software Classic 6 enabled them to sketch other graphs (families) by relating to their mother (basic) graphs. These findings corroborate those of Jenkin, Van Zyl and Scheffler (2015) whose ideas encourage learners to always start with the basic graph (mother graph) when sketching trigonometric functions graphs. The first-year students in this research went further to draw Hyperbolic Functions graphs without the mother graph and this showed the strength of GeoGebra Software Classic 6 in enhancing first-year students' understanding and graphing skills of Hyperbolic Functions. This is in line with Mills' (2006) observations that learners who are active in technology integration use technology to manipulate subject content and at the same time acquire advanced reasoning and understanding skills. In consistence with this is the constructivist view that technology (in this case GeoGebra Software Classic 6) is used by students as a tool in lessening cognitive burdens (Demir, 2012).

Effect of GeoGebra Software Classic 6 on Gender in relation to Graphing of Hyperbolic Functions

The findings of this study with regards to gender revealed that there was no statistically significant difference in graphing skills between male and female first-year students taught using GeoGebra Software Classic 6 (experimental group) and Traditional Method (Control group). Table 4 shows that male and female first-year students in the experimental group were equivalent in graphing Hyperbolic Functions before the intervention (pre-test means scores) with the control group. This is evidenced by an independent samples t-test for pre-test in Table 3 whose t-value was -1.131 for 48 degrees of freedom, p-value was 0.896 under two tailed. Since p-value is greater than the level of significance $\alpha = 0.05$, then male and female learners were equivalent in terms of graphing Hyperbolic Functions before they were exposed to GeoGebra Software Classic 6. Table 5 also shows an independent samples t-test for post-test, t-value was .226 for 48 degrees of freedom and the p-value was .822 under two tailed. Since the p-value is greater than 0.05 ($p > 0.05$), then there was no statistically significant differences in the post-test mean scores of male and female first-year students taught using GeoGebra Software Classic 6 (experimental group) and Traditional Method (Control group).

Male and female first-year students taught in the experimental group (taught how to graph Hyperbolic Functions using GeoGebra Software Classic 6) performed the same on average in terms of mean scores and the Control group taught with Traditional Method in both PreHFAT and PoHFAT. When the independent samples t-tests were done for first-year students with respect to gender in the experimental group and control group, there was no statistically significant difference in achievement between male and female first-year students. One possible explanation to this finding is attributed to the fact that both male and female first-year students were exposed to same software-rich learning environment. GeoGebra Software Classic 6 gave both male and female first-year students in the experimental group and control group the same opportunities on how to graph Hyperbolic Functions through exploration and visualization.

GeoGebra Software Classic 6 acted as an important scaffold for both male and female first-year students to bridge the gap in the zone of proximal development as advanced by Vygotsky's social development theory (Vygotsky's, 1986). This finding showed that GeoGebra Software Classic 6 created an enabling learning environment that accorded equal chances of learning to both male and female first-year students. The study also revealed that GeoGebra Software Classic 6 allowed male and female first-year students to learn how to graph Hyperbolic Functions at the same level and this led to a conclusion that GeoGebra Software Classic 6 is not discriminatory gender-friendly and it impacts positively on both male and female first-year students.

The findings of this study are in agreement with the study done by Shadaan and Leong (2013) who found that high level of corporation was visible among female and male students as they were helping each other most of the time. Therefore, researchers infer that working in groups and the degree of interaction between first-year students are huge benefits of using technology, students were passionate to demonstrate their skills and transfer their recent experience to their colleagues. Students in many occasions are better teachers; they can communicate with each other and positively interfere to clarify some misconceptions or vague points.

Effect of GeoGebra Software Classic 6 on First-Year Students' Confidence on how to Graph Hyperbolic Functions

Based on the findings from Table 6, it was evident that there was positive effect of GeoGebra Software Classic 6 on first-year students' confidence on how to graph Hyperbolic Functions. Tables 5 showed that the pre-test overall confidence mean for experimental group was 4.15 (SD =14.23) and that of the control group was 3.82 (SD=10.76). This means that both experimental and control groups developed negative confidence (low confidence) on how to graph Hyperbolic Functions. In Table 6, the confidence mean response for post-test of 7.67 for experimental group on the five-point Likert scale showed a positive confidence on how to graph Hyperbolic Functions (7.67 >5) and the confidence mean response of 6.19 for control group also showed positive confidence to learn how to graph Hyperbolic Functions on the five-point Likert scale (6.19 > 5). This means that both experimental and control groups developed positive confidence. Nevertheless, the confidence mean response in experimental group is higher than the confidence mean response in the control group (mean = $7.67_{\text{experimental}}$ and 6.19_{control}). These results showed that GeoGebra Software Classic 6 had more positive effect on the confidence on how to graph Hyperbolic Functions in the experimental group as compared to control group which was taught using traditional teaching method without GeoGebra Classic 6 software. This rise in positive confidence for first-year students in the experimental group showed that using GeoGebra Software Classic 6 in teaching and learning of how to graph Hyperbolic Functions enhanced first-year students' confidence to learn the topic. On the other hand, the marginal rise in positive confidence developed by first-year students in the control group was as a result of group discussions that were done during lessons.

The findings of this study are in harmony with the study done by Karadag and McDougall (2011) who found that students' confidence and motivation to learn in the group of GeoGebra clearly increased and students were excited to practice new situations where they were going to investigate the effects taking place when changing the parameters' values in a quadratic function. Therefore, researchers argue that using the graphing application like GeoGebra Software Classic 6 provides students with instantaneous feedback on their responses to questions, which adds an internal stimulus for learning.

CONCLUSION

This study investigated the effect of GeoGebra Software Classic 6 on first-year students' graphing skills of Hyperbola Functions and Confidence in Lusaka district. The study findings showed and provided evidence that using GeoGebra Software Classic 6 has a positive effect on first-year students' graphing skills and confidence in Hyperbola Functions. The results have also shown that graphing Hyperbolic functions using GeoGebra Software Classic 6 is more effective to graphing without it in enhancing graphing skills and confidence of the first-year students. First-year students who learnt how to graph Hyperbolic Functions with GeoGebra Software Classic 6 had improved their graphing skills after the treatment as it was shown in their higher scores than those who learnt the topic without using GeoGebra Software Classic 6. The GeoGebra Software Classic 6 also allowed male and female first-year students to learn how to graph Hyperbolic Functions at the same level and this led to a conclusion that GeoGebra Software Classic 6 is not discriminatory and it impacts positively on both male and female First year students. Furthermore, the results obtained from the questionnaire indicated that first-year students who were taught using GeoGebra Classic 6 software developed more positive confidence on how to graph Hyperbolic Functions than their counter parts that were taught without using GeoGebra Software Classic 6.

From the findings of this study, it can therefore be concluded that using GeoGebra Software Classic 6 on how to graph Hyperbolic Functions is an effective way of improving first-year students' graphing skills and enhance confidence of first-year students on how to graph Hyperbolic Functions.

RECOMMENDATIONS

1. Lecturers of Mathematics are advised to utilize the graphing application GeoGebra Software Classic 6 in their lecture theatres.
2. Lecturers of Mathematics in Higher Learning of Institutions should consider applying research-based teaching tools such as GeoGebra Software Classic 6 to teach First-Year students on how to graph Hyperbolic Functions.
3. Lecturers should consider implementing GeoGebra Software Classic 6 in their teaching "to explain, to explore, and to model mathematical concepts and the connections between these concepts".
4. Lecturers of Mathematics lecturers in Higher Learning of Institutions should incorporate GeoGebra Software Classic 6 in Mathematics topics that are perceived to be difficult for both students and lecturers such as Conic Section and Trigonometry.

5. Lecturers of mathematics in Higher Learning of Institutions should be encouraged to use GeoGebra Software Classic 6 in the teaching of how to graph Hyperbolic Functions.
6. Since the use of GeoGebra Software Classic 6 in graphing Hyperbolic Functions proved to be effective, the research should be conducted on a large scale and in other topics in mathematics to see if the same results can be obtained.

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