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INVESTIGATING GENDER DIFFERENCES IN USING GEOGEBRA SOFTWARE AT THE SENIOR HIGH SCHOOL LEVEL

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ABSTRACT: *The study aimed to investigate the effects of GeoGebra software on students' performance based on gender in mensuration at the Senior High School Level. Research hypothesis was used to conduct the study. Quasi-experimental (pretest-posttest design) was used in this quantitative study. Tests were used to collect data for the study and the collected data was analyzed using Statistical Package for Social Sciences (SPSS). It was therefore concluded that both genders are of the same academic abilities in geometry. It was also revealed that performances of students based on gender were not significantly different, which showed that both genders performed equally. Also, GeoGebra as a teaching and learning tool enhanced students' performance in mathematics. It was therefore recommended that the use of GeoGebra should be made to part of the Senior High School Curriculum and teachers should be sensitized about the essence of the use of technological tools in teaching mathematics.*

KEYWORDS: Gender, GeoGebra Software, Academic Performance.

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INTRODUCTION

According to Bassey (2020), mathematics is the foundation for both national and global growth, and it is required for understanding and exploiting science and technology. Mathematics is important for both literate and illiterate sections of society due to its use in daily life, including transportation, commercial activities of all types, and contributions to scientific and technological advancement (Golji & Dangpe, 2016). Learning mathematics necessitates that students first comprehend mathematical ideas in order to solve problems, apply what they have learned in the real world, and develop mathematical skills, all of which are objectives of learning mathematics (Herawati, Hidayati & Iffah, 2023). According to Auliya and Munasiah (2016), one of the crucial components in tackling future difficulties is students' capacity to understand mathematical concepts.

Technology is an essential component in national development; in today's world, technological expansion contributes to social and economic development. Science and technology have become dominating power development tools in today's society. Countries such as Russia, Japan, America, and China are examples of developed countries because of their advancements in science and technology. GeoGebra is a technological tool that includes all mathematical features. It is a program that includes a lot of interactive geometry software for math instruction (Dahal, Shrestha & Pant, 2019). Ghana Education Services encourages teachers to include ICT into their classroom lessons. According to Bhagat and Chang (2015), using ICT in mathematics instruction engages students at all levels. Their result revealed that they perform well in their academics. They carried out a study on GeoGebra software, employing GeoGebra as an intervention tool to teach Geometry concepts, and discovered that the experimental group's outcomes were positive, as were perceptions of the effectiveness of GeoGebra and ICT tools for learning.

One of the internal elements in the learning process is gender. Gender is a quality or sign (attribute) that is associated to a specific gender and is based on society, custom, habit, or psychology and biology (Pamungkas & Siswanto, 2021; Sumayanti & Siswanto, 2021). Gender, according to another definition, is an indicator of features that distinguish men and women when seen from a socio-cultural perspective, level of mental strength, psychology, and other non-biological elements (Marzuki, 2007). Gender originates naturally by nature from the divine, gender may be classified in terms of behavior that can be formed by social processes; hence, the term gender is frequently used to refer to culture (culture), where difficulties and issues linked to behavior frequently emerge. Women and men have been ascribed different behaviors, positions, rights, and functions (Syaribulan & Nurdin, 2015). Today's society views women as weak, and numerous studies show that women dislike ICTs. According to various opinions, gender is a special characteristic that distinguishes between men and women when viewed from various perspectives, including not only the biological aspect, but also the socio-cultural aspect, psychology, mental strength, and other non-biological factors. This is supported by research findings. The findings revealed that boys employ spatial talents while girls use logical reasoning abilities. As a result, research suggests that girls outperform boys in terms of conceptual comprehension capacities (Ramadhina et al., 2021).

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Problem Statement

The subject of students' underperformance in mathematics in Ghana's Senior High Schools has been widely discussed. It is critical to understand the reasons and root causes of this problem in order to fix it. Many people have studied the causes of failure and solutions to poor math performance. These issues have been investigated from a variety of viewpoints, including the involvement of students, teachers, parents or family, school environment, society, government, and so on. Among these are the effects of students' study habits (Ayodele & Adebiyi, 2013; Obasoro & Ayodele, 2012), parents' economic status (Osonwa et al., 2013), school environment (Okoro, 2004), and teachers' competencies (Akiri & Ugborugbo, 2009). Many factors contribute to the diverse conclusions reached by all studies. Campaigns for understanding of and implementation of gender equality in the research area are examples of such factors. Ghana has diverse regions and tribes with different sociocultural origins and belief systems; so, campaigns, understanding, and implementation of gender equality in different parts of the country vary.

Another cause for the disparity in conclusions is the issue on which gender equality is tested. For example, there has been widespread concern regarding gender variations in student performance in mathematics and the use of ICT, and some research has been conducted in this area in many regions of the world, but the rural areas were left out. Although some researchers discovered no significant differences in male-female mathematics ability at any level, the majority discovered gender disparities (Atovigba, 2012). In reality, it has long been assumed in most sections of the country that male students outperform female students in mathematics and technology tools. Hence, this study seeks to investigate the effects of GeoGebra on student's performance based on gender in the less endowed schools the Upper East Region.

Purpose of Study

The study seeks to investigate the effects of GeoGebra on students' performance based on gender in the Bongo Senior High School.

Objectives

Investigate whether there are gender differences in geometry achievement among students taught using the GeoGebra Software.

Research Hypothesis

H_0: There is no statistically significant difference in the posttest mean score of the by gender.

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LITERATURE REVIEW

Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) was developed by Davis. Technology Acceptance Model is a theory about information systems (Davis, 1989). The model examines how customers accept and make use of innovation. The Theory of Reasoned Action (TRA) model, from which the model derives, is used. He contends that the number of factors determine how and when to use technology, with handiness and perceived convenience being two of the most important. The model encourages research on what factors influence a person's computer usage habits. The TAM was improved and specially designed for modeling information system user acceptance based on TRA. Chuttur (2009), criticized Cap as having poor heuristic value, limited logical and prescient force, formality, and a lack of any logical worth. Due to these responses, the hypothesis was eventually changed to fit the new UTAUT paradigm. The development option, as described above, according to Rogers (2003), lists the steps individuals or organizations take to appropriate advancements. It starts with keeping aware of the development or being aware of it, moves on to framing mental models of the growth, and ultimately triggers a decision on whether to accept or reject. Once a decision has been made, the specific organization then actualizes and affirms the decision. In any event, the author observed that some characteristics of the person, such as their financial situation, personality, and communication style, could increase familiarity with the development. In essence, five factors relative to favored location, resemblance, perceptibility, trialability, and intricacy of the development affect the impact or demeanor layout stage. Through their experimental findings, other scholars have backed Rogers' claim that these factors determine the probability of selection rate (Kesse-Tachi, A. 2016; Tagoe, 2013). A study was conducted by Akwensi, V. K. et al. (2023) on the effects of GeoGebra on students' performance; it was concluded in their study that students who used GeoGebra software performed better than their counterparts taught using the traditional method.

Gender Based Analysis on ICT in Learning

Yu (2021) investigated the effects of age, gender, and previous computing experience on computer attitudes in two age groups, thus, aged 11-12 and 15-16 years. The results revealed that males from both age groups indicated better experience with and more favorable opinions about computers than their female colleagues. More specifically, the study discovered that males had more computer experience than females, in line with several previous studies. Males outnumbered females in terms of home computer ownership or access, frequency of use, and overall computing experience. Males had a higher overall fondness for computers than females, and this preference did not change between age groups. Considerable research exists on the effect of teachers' demographic variables like gender, age and teaching experience on their ICT adoption (Rahimi & Yadollahi, 2011, p. 18) Research into the impact of gender on ICT use in modern society shows differences between males and females. For example, Broos (2005) reveals significant gender differences with regard to attitudes to ICT. Men hold positive attitudes to computers and the Internet whereas women display higher levels of computer anxiety. Moreover, men have greater computer experience and, compared to women, consider themselves as being ahead of others concerning computer or Internet use. In most applications, male teachers evaluated their skills as being higher than their female colleagues. Yet, a more recent study of the digital competence of 2,477 upper secondary school teachers indicates a

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different trend. It shows that, in this regard, women have a higher mean score than men (Krumsvik et al., 2016, p. 157).

In Siddiq and Scherer's (2016) research on the relationship between the teachers' emphasis on the development of students' ICT skills and computer self-efficacy, gender and age were investigated as moderators. The findings show that, contrary to age, the moderation effect of gender was limited, relating only to the use of computers for instructional purposes. The interaction between gender and age did not show a statistically significant moderation effect. Scherer and Siddiq (2016) conducted a study on teachers' computer self-efficacy using the data obtained from the Norwegian secondary school teachers who participated in the 2013 International Computer and Information Literacy Study. Teachers' computer self-efficacy was conceptualized as their confidence in performing basic and advanced skills in using computers and the use of computers for instructional purposes (Scherer & Siddiq, 2016, p. 48). The results revealed that male teachers, compared to female teachers, showed higher levels of computer self-efficacy in basic and advanced operational skills. However, there was no statistically significant gender difference in the third dimension of computer self-efficacy, using computers for instructional purposes. Tertiary institutions have started engaging students using online platforms for teaching and learning (Anaba, 2020; Ashesi University, 2020). At the college level, the NCTE with support from Transforming Teacher Education and Learning (T-TEL) has established a Virtual Learning Taskforce for Teacher Education (Boakye, J. A., & Akwensi, V. K., 2023).

As the use of technology in EFL classrooms has increased significantly, a large amount of research has been conducted to better understand how children perceived the use of ICT in EFL instruction. The majority of students, according to many of these studies, have a positive perception of the usage of ICTs in the classroom. Sanders and Morrison-Shetlar's (2002) study confirmed that students' attitudes toward technology are influential in determining the educational benefits of online learning resources and experiences. According to Angers and Machtmes (2005), instructors' attitudes and beliefs are crucial for the success of technology-based learning. Because teachers' ideas, attitudes, and ICT expertise and skills are disregarded, many programs to integrate ICT into learning have failed (Jimoyiannis & Komis, 2007).

RESEARCH METHODS

Positive philosophy is the foundation of this study. According to positivists, reality is constant and can be observed and described objectively without the researcher interfering with the phenomena being investigated. A natural science philosophy known as positivism emphasizes the discovery of logical or mathematical evidence through statistical analysis as well as the scientific testing of theories (Collis & Hussey, 2014). The positivist approach to research led to the selection of the quantitative research methodology. The goal of quantitative research is to collect data that can be quantified and statistically analyzed to confirm or refute competing scientific hypotheses (Creswell, 2003).

For this study, a quasi-experimental (pretest-posttest design) was used. According to Vanderstoep and Johnson (2009), a quasi-experimental study uses empirical data to determine the causal effects of treatment (intervention) on the population it is intended to reach. The quasi-experimental research design was employed for this study because the study was carried

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in a normal school setting where intact class were used, thereby making randomization impossible. The population of the study was 30 students. An intervention planned was taken by teaching. The students received planned and delivered instruction. The students were taught using GeoGebra.

The instrument used to collect data for the study was test. The test was developed by the researcher. The test (pretest and posttest) contained twenty multiple choice and five theory items each. The test items were developed in accordance with core mathematics syllabus for senior high school. After the test, the scripts were marked and results were recorded for further analysis. The reliability of the instrument was ensured by using a pilot study from Bolgatanga Senior High School in Bolgatanga Municipality on both the test and questionnaire. The two sets of scores obtained were correlated using the Pearson Product Moment Coefficient for test which yielded a coefficient of 0.81 and 0.86 for the pretest and posttest respectively. Also, the reliability of the questionnaire was determined by calculating the Cronbach alpha, which yielded 0.72.

The main statistical methods used for the study's hypothesis were the t-tests.

RESULTS AND DISCUSSION

H_0: There is no statistically significant difference in the posttest mean score of the experimental group by gender.

Table 1: Statistics of Pretest and Posttest Mean Scores of Experimental Groups

Test	N	Mean	Std. Dev.	Maximum	Minimum
Pretest (Experimental)	30	9.10	3.736	15	0
Posttest (Experimental)	30	14.87	4.696	24	6

Source: ***Fieldwork, 2022.***

A cursory look at Table 1 indicates that the mean scores between the pre-test (9.10) and the post-test (14.87) increased. The demonstration from Table 1 above shows that there was an improvement in the control group, although it was not as significant as in the experimental group (those taught using the GeoGebra software).

Table 2: Independent Sample T-test of the Posttest Mean Scores of the Experimental Group Based on Gender

Gender	N	Mean	Std	t	df	Sig.
Male	12	14.33	5.60	-0.50	28	0.62
Female	18	15.22	4.12			

Source: ***Field Survey, 2022***

From Table 2, it is revealed that the post-test mean score is 14.33 for males and 15.22 for females. A difference of 1.11 is realized. Again, a sig. value of 0.62 as against a significant level of 0.05 is obtained from the independent sample t-test. Since 0.62 > 0.05, we therefore failed to reject the null hypothesis that stated that there is no statistical significance in the post-

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test mean scores of the experimental group based on gender. Statistically, students' performance was the same among students of the experimental group based on gender.

The results showed that using GeoGebra as a method of instruction enhanced student performance by providing them with fresh experiences in mathematics, especially when teaching geometry principles. Students were given the opportunity to visualize the ideas being taught, to relate those ideas to their surroundings through real-life pictures, and to interact with the software by customizing a variety of tasks. (For instance, the size of a circle was determined by the length of the radius.)

The study revealed no significant difference in the performance of students in the experimental group based on gender. This implies that the use of GeoGebra software provides students equal opportunity to excel academically in mathematics. This result confirms the findings of Thakur (2014), whose research revealed a no significant difference in the performance of students in mathematics based on gender after the use of the ICT software. Conversely, the findings of Broos (2005) reveal significant gender differences with regard to attitudes to ICT. Men hold positive attitudes to computers, also that males performed better than females after ICT tools were employed in teaching mathematics. Again, Krumsvik et al. (2016), concluded in their research study that female students performed better than their male counterpart.

CONCLUSION

The study revealed no significant difference in the performance of students in the experimental group based on gender. This implies that the use of GeoGebra software provides students equal opportunity to excel academically in mathematics. This result confirms the findings of Thakur (2014) and Broos (2005). Also, it was recommended that equal attention should be given to both genders.

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