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INTERACTIVE COURSEWARE AND ACADEMIC PERFORMANCE IN GEOMETRY IN JUNIOR HIGH SCHOOLS

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ABSTRACT:*This study aimed to see how beneficial employing interactive courseware in teaching geometry improved students' academic performance. The study tested how an interactive computer-based application could affect students' academic performance in junior high schools(JHS) students through a quasi-experimental design. The study tested four null hypotheses in determining whether there is any statistical significance in performance between the experimental and control groups. Data was collected using a questionnaire and an achievement test. Data analysis was conducted using the paired sampled t-test and descriptive statistics. The findings of the pre-test revealed that there was no significant difference between the two study groups. After the study, a substantial difference between the two study groups was discovered. The study found that using computer-based software to teach Geometry increased students' performance at the junior high school level. The study recommends that teachers consider integrating computer-based courseware in the learning of mathematics to improve students' performance.*

KEYWORDS: interactive, courseware, performance, experimental, computer-based, compute assisted instruction

INTRODUCTION

All instruction during mathematics teaching should allow students to reason and apply skills and concepts learned to unfamiliar situations. These skills should also help students gather and communicate information, enabling them to solve problems (NCTM, 1989). According to Anstrom (2006), teaching mathematics involves using instructional materials that aid the student in mastering the skills and concepts necessary for mathematical literacy. The focus has shifted to how computer technology can help learn mathematics, such as geometry, statistics, and problem-solving (source). The integration of technology in mathematics has increased, promoting increasing proficiency levels in the subject (Pea, 1987). Many students find mathematics difficult to master despite understanding its importance in their lives(source). This situation arises mainly

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from the instructional methods used, focusing on memorizing skills instead of applying them (Kaufman, 2008; CEO Forum, 2001; Cain-Caston, 1993; Brown et al., 1988).

Studies spanning decades indicate that mathematics instructions, especially at the secondary school level, are mostly teacher-centric, emphasizing mostly content coverage than assisting students in grasping the content and applying the knowledge in real-world situations (Jones, Fujita & Ding, 2006; Fengfeng 2008). With this noticeable problem, a recent study of the application of technology in learning in the Sub-Saharan region alluded to the technology's viability in improving learning in the area, especially mathematics (Tilya, 2008). This is demonstrated in technology's ability to support collaborative learning, which emphasis learner agency. In this way, the student is in charge of the learning process, dispelling the myth that the instructor is the only source of knowledge. Similarly, Keong, Horani, and Daniel (2005) found that incorporating technology into teaching and learning increases overall learning outcomes. Students find it easy to grasp and understand the learning instructions in these subject areas. Voogt (2003) mentioned that technology in education positively impacts teachers' and students' learning processes. Additionally, technology use in the classroom supports a constructivist pedagogical approach where students focus on applying acquired knowledge to solve problems rather than mere calculations.

Problem Statement

In Ghana, technology is perceived as an enabling pathway that helps students and graduates develop requisite contemporary skills and knowledge necessary to create, sustain, and even advance their competitiveness in the global economy (Ministry Of Education, 2006). Similar initiatives, such as the 2003 strategy on information and communication technology for accelerated development (ICT4AD), gave guidance for incorporating ICT into the education sector. The policy recommended several reforms in the education sector to see technology integrated into the curriculum, encouraging teachers to utilize ICT resources to improve learning outcomes in Ghana. Such initiatives were informed by the assertion that ICT facilitates learning outcomes by providing the best learning experiences for educators and learners, making learning interesting and hooking learners into learning instructions (Agyei, 2013). However, getting a positive impact from ICT depends on integrating it during the teaching and learning processes (Galbraith, 2006). With all these benefits of applying technology in education, constant efforts have been made in the use of ICT in the Ghanaian mathematics curriculum, a move that is viewed as critical in improving learning outcomes in these areas (Assuah, 2010; Yidana & Amppiah, 2003; Dontwi, 2001). To achieve this goal, a lot of research is required to identify the strategies that apply in the Ghanaian context, bearing in mind the dismal performance in the area of Mathematics at the high school level that has left many stakeholders, including senior education and policy experts worried about this trend (Sarfo, Eshun, Elen & Adentwi, 2014). As calls for immediate intervention, some scholars point to limited usage of computer technology and scientific calculators as among the reasons for poor performance in Mathematics at the Junior High School level in Ghana (Asabere-Ameyaw and Mmereku, 2009). The proposed solution is technology integration into STEM

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subjects, particularly mathematics, right from the Basic Education Level. The majority of Ghanaian JHS students, according to Baffoe and Mmereku (2010), have a weak conceptual comprehension of mathematics taught at this level. They also pointed out that before joining JHS, the learning outcomes in geometry among Ghana's JHS were significantly worse than in other regional nations such as Nigeria and Sierra Leone.

Additionally, most Ghanaian students have inadequate cognitive learning strategies. The discrepancies in learning outcomes between Ghanaian students and other regional students are attributed to phased-out instructional materials and teaching techniques (Baffoe & Mmereku, 2010). As such, appropriate application of technology in disseminating instructional materials, especially in the areas of geometry, is proposed as an appropriate mechanism that would give students a rich learning experience with lots of hands-on activities that would improve their engagement in the classroom, a move that would improve the overall learning outcomes in the area of geometry (Baffoe & Mmereku,2010).

The traditional approach to teaching mathematics renders students passive listeners and deprives them of thinking critically, especially when dealing with geometry. The passive approach to teaching geometry focuses on how much content a student can memorize instead of what the student can analyze and apply (Mehdiyev, 2009). West African Examination Council reports also depict poor performance in the Basic Education Certificate Examination (BECE), especially mathematics. The reports indicate that most of the students who sat for the exam had poor performance, well below 62.62%. Conclusions from the report suggest that more effort is needed in improving the instructional and learning methods., Studies spanning decades have looked into the positive effects of applying technology in education (Yidana & Amppiah, 2003). Therefore, mathematics teachers must come up with new ways to enhance the learning of the subject.

Students still perceive mathematics to be conceptual, and many instructors still find it difficult to make mathematics exciting for them. (Boaler & William, 2002; Heintzel & Reichenbach, 2018). When solving difficult concepts, the majority of students expressed varying degrees of dissatisfaction since they needed to turn the issues into algebra before applying algorithms, and the majority of them were unable to do so (Martin et al., 2018). Teachers' technical approach of providing learners with equations in icon form and then guiding them through the application of associated algorithms are simply insufficient (Freire, 2018; & Green, 2017). While ICT is increasingly being integrated into the teaching processes, there have not been many studies that examine the use of computer-based interactive courseware in teaching in Ghana. This study looked at computer-based interactive courseware as a teaching medium and how it might supplement traditional teaching methods.

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Study Objectives

The research was intended to:

1. Establish the effectiveness of ICT-based interactive courseware as a teaching method compared to the traditional instruction method for plane geometry.
2. Identify the effectiveness of ICT-based courseware as a teaching method compared to the traditional instructional approach of the high-achieving students of both the groups tested in the study.
3. Establish the effectiveness of ICT-based interactive courseware as an instruction method compared to the traditional instructional method for low achieving students of both groups in the study.
4. The difference in the attitudes of both groups in the instructional methods used respectively.

Hypotheses

H_o1: No difference is apparent in the mean scores of the students taught plane geometry and angles in mathematics using computer-based interactive courseware and those taught using the traditional teaching approach.

H_o2: No difference is apparent between the mean scores of the high achievers of both study groups.

H_o3: No difference is apparent between the mean scores of low achievers in both study groups.

H_o4: No difference is apparent in the attitude of the experimental group towards ICT-based courseware and the attitudes of the control group towards the conventional methods of teaching mathematics.

Significance of the Study

Firstly, a study of this nature will provide insight into computer-based interactive courseware as a medium of instruction to improve student's learning outcomes. However, little is known about schools that implemented such programs. The study will provide educational administrators and curriculum developers with an appropriate teaching medium.

Again, findings will also help mentees when they face problems of the abysmal performance of students in geometry during their teaching practice. Thus, it will help them know how to go about such a problem if they read this dissertation when published and even adopt the software to address the diagnosed problem in geometry. It will serve as a source of reference to education stakeholders to take pragmatic decisions and enact policies to promote computer-based interactive courseware as an instructional strategy in our classrooms.

LITERATURE REVIEW

Computer-Assisted Instruction versus Traditional teaching and learning

When Computer-Assisted Instruction (CAI) supplements conventional teaching methods, students perform much better than traditional instruction methods used in isolation (Cotton, 1997). Students also learn faster and remember more when using computers than when learning using conventional methods in isolation. Similarly, University students taught using the lecturing method, and CAI has obtained high exam score averages than students relying on lectures only (Basturk, 2005). Akour (2006) supported Cotton's assertion, explaining that university students are taught traditional methods and CAI. Perform significantly better than students taught using the conventional lecture-only approach. There is little experience combining traditional teaching methods with technology such as computers since this technology is relatively new. Developments in technology and innovations mean that integrating these technologies in the classroom should provide students with an environment better suited for their learning (Cradler, McNabb, Freeman & Burchett, 2002). Studies have indicated that CAI is more effective than Teacher Assisted Instruction (TAI). In contrast, other studies have shown that TAI is more effective during the initial knowledge acquisition phase, while CAI is more effective for knowledge retention (McCollister, Burts, Wright & Hildreth, 1986).

Indeed, interactive courseware increased learners' interest in engaging with instructional materials as they became more attentive and alert than when they were in traditional classroom settings. Similarly, interactive courseware and computer platforms' easy and quick assessment mechanisms improved learning outcomes among students (Hunter, 1982). Goode (1988) again noted that elementary students, especially those in the fifth and sixth grades who used computer-assisted instruction, scored highly in mathematics than traditional teaching approaches.

Edward, Norton, Taylor, Weiss, and Dusseldorp (1975) discovered that mathematics applications supplemented with computer-assisted learning are significantly more effective in fostering student achievement. Likewise, Harrison and Van Devender (1993) found improved achievement among primary pupils with computer knowledge, especially in multiplication and subtraction, compared to their counterparts who had only traditional knowledge.

The General Structure and Flow of Computer-based Interactive Courseware

Courseware is computer resources or educational material designed to aid in educational or training courses (AiniArifah and Norizan, 2008). They observed that courseware includes meticulously selected materials aimed at facilitating the learning process among students. These materials provide interactive platforms where students can interact with the instructional materials through tutorials, drills and practice, instructional games, and simulation. Additionally, courseware combines multi-texts such as images, texts, videos, and other interactive materials displayed on the dashboard. It can be easily accessed by computer or electronic devices such as laptops or

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smartphones. Inglis et al. (2002) argue that interactive courseware is software used in education with interactions between the user and the presenter. Varying types of courseware such as linear presentation webpages, PowerPoint, or learning apps avail complex yet interactive interfaces that require learners to navigate through the platform to access and interact with the instructional material they need. Most ICT-based courseware is almost similar in its basic structure (Tang, Hanneghan, & El-Rhalibi, 2007). Most of this courseware comes in tutorials delivered via computer software (Tabassum, 2004). The interactive courseware is designed to give material to students in the form of a presentation, following which they respond to questions and receive feedback on each one. In most cases, the responses given by the student do not affect the order of the presentation. Interactive courseware teaches new skills and materials and also helps the learner to practice complex and straightforward questions.

Effectiveness of Computer-based Interactive Courseware as a Teaching Strategy

More researchers have concluded that when young children learn with the computer, it allows them to obtain knowledge. (Haughland & Wright, 1997; Siu & Lam, 2005). McCollister, Burts, Wright, and Hildreth (1986) stressed that computers could be a developmentally appropriate tool for learners to acquire knowledge. It would be beneficial to be aware of the implications on children's learning outcomes when creating and implementing early childhood curricula. Haugland and Ruiz (2002) agreed with McCollister *et al*. that children learn best when working with their peers and using a computer. Students are sufficiently engaged by game-like interactions that are gamified learning. Despite the fact that much educational software is interactive, the majority of it does not genuinely "interact" with students; instead, they guide students on accessing learning instruction and track their progress in the process by telling them whether they have answered the questions correctly. This puts the student as the real agents of learning, enabling them to progress with learning even in the absence of an instructor and develop critical thinking skills in the process (Report to the President, 1997). Several studies (e.g., Cohen, 1997) further assert a positive association between computer use and learning outcomes. They argue that computer technology promotes interest in learning among students through multi-texts and promotes all learning types, which cater to the unique needs of different students.

Bragg (2006) outlined the use of two courseware in mathematics teaching and raised questions about grouping learners according to ability when practicing courseware. The use of courseware in mathematics teaching, in particular, aimed to develop guidelines for maximizing the effectiveness of courseware. These guidelines are noted using Geometer's sketchpad as an example. Courseware geometer's sketchpad is a piece of software that allows you to measure segment angles, area, perimeter, and lengths using cognitive computing at its most basic level. The construct function, which allows the user to make items from selected objects, is used. Asplin (2003) stated in her study that simply playing Geometer's sketchpad as a time-filler or casually was not enough to improve mathematical skills. For courseware to effectively improve students' performance, it needs to be elevated from a mere time-filler to become part of the core teaching tools. Asplin (2003) also notes that the teacher facilitates learning by asking the students to be vocal in a classroom

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environment. Students are grouped according to their abilities. There were much more significant gains in mathematics comprehension when CAI was used.

According to Mok (2000), interactive courseware can help students improve their mathematics skills by exposing them to "real world" situations that connect abstract concepts to everyday activities that the learner already understands are important for remembering what they've studied. Kulik (2003) also agreed with Mok (2000) that interactive computer-based education helps increase students' understanding and retention. According to Kulik (2003), pupils' results might improve from the 10th to the 20th percentile while learning time was reduced by a third. Computers also boosted class performance by half a standard deviation, according to him.

Perceptions of the use of computer-assisted learning

One of the characteristics that predict people's conduct is their attitude (Yushau, 2006). This study describes attitude as a learned behavior that expects a person's reaction towards their environment. These beliefs typically influence people's actions and behaviors and ultimately determine outcomes. This connotes that attitude is one of the main determinants of people's behavior (Yushau, 2006). Computer attitude is either positive or negative feelings towards computers and activities carried out using computers (Smith, Caputi & Rawstorne, 2000). According to Maio and Haddock (2010), attitude determines a person's emotions associated with something, whereas the cognitive part describes beliefs and reasoning processes. The behavioral component determines how the person ultimately acts towards the object. People's views about individuals, objects, and events might be positive, negative, or ambivalent. According to Ruch (1958), attitudes are also learned behavior of the individuals. We learn about people, societal issues, and educational circumstances as we grow up. As a result, students' feelings about computers in the classroom could be good, negative, or neutral.

Smith et al. (2000) defines computer attitude as a person's overall perception or feeling about computer technology and related computer activities. The evaluation of attitudes towards computers mainly examines how students interact with computer hardware, software, and other people's use of computers. The examination of computer use can involve single instances such as using specific software or a group of behaviors on computer use such as computer courses (Smith *et al*., 2000). Researchers have devised several computer attitude scales, but Loyd and Gressard's scale is most used (1984). Different variables influence computer attitudes. Rhoda and Gerald's (2007) findings on exposure of students to computer use were rather contrary. Positive attitudes were exhibited by students who were poorly exposed than those who had computers at their disposal. According to Jana and Pavol (2008), a study of students' attitudes toward computers conducted in Slovakian schools indicated that schools had a significant impact on behavioral elements of ICT attitudes. These factors typically interact with each other to affect attitude towards computers. Several studies have been carried out that reveal teacher ineptness in computer use as one of the main challenges to integrating computer use in the classroom environment (Sadık, 2006). It is imperative to ensure both teachers and students know their attitudes towards computers to

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improve learning. To obtain the best results from computer education of the teachers in helping the students develop positively towards the use of a computer assume great importance. The classroom positively impacts pupils' attitudes toward cooperating with the teacher (Tondeur, Valcke, & Van Braak, 2008). Working with a computer is more difficult than working with paper. Lamberty and Kolodner (2002) found that students who worked with papers were interested in using computers.

Garland and Noyes (2005) conducted a study that established a positive correlation between confidence and computer attitude. Taghavi (2006) investigated undergraduate college students' attitudes toward computers, focusing on the relationship between age and computer attitudes and whether students had access to a computer at home and collegiate categorization. His research discovered that age has little bearing on people's attitudes about technology. Access to a home computer, on the other hand, was linked to learning and working with computers. The survey also discovered that collegiate classification has a substantial impact on computing attitudes. Senior students had much more positive feelings about computers than sophomores and juniors. According to Gao (2005), students' views regarding computer use in education positively correlate with their perceived utility of computers. Learners who did not think computer education was vital had bad feelings about using computers in school. Teachers resist using technology in the classroom, according to Tezci (2010), due to a lack of proficiency. According to Saari, Juanna, Wong, Ivan, and Samsilah (2005), teachers who often used computers in the classroom had a favorable impression. However, the study suggested that more research be done into instructors' views about computer use. According to Salih, Mustafa, and Mehmet (2009), teachers expressed good computer and internet use opinions.

The benefits of computer-based interactive courseware in the mathematics classroom.

There are numerous advantages to using a computer. Computers retain excellent records, give instant feedback, enable online learning, and allow for unlimited repetition. Instructors are critical in computer-based learning environments because they provide academic guidance, point students to appropriate resources, and social reinforcement. The best developmental programs consider both the advantages and disadvantages of computer-assisted learning. The existing teaching resources are used to create new interactive programs. After observing an activity (or skill), the student is directed through related difficulties before being allowed to tackle the problem independently. With the system designed to give immediate feedback, students are allowed to assess their level of understanding of the instructional materials as they build new knowledge in the process. This frequent assessment and feedback level has proven further to improve learning outcomes (Boylan, 2002). Another significant advantage of employing computers in developmental programs is increasing students' participation in the learning process. The program must be interacted with by the student. Researchers have discovered that introducing interactive video training into the curriculum improves instructional consistency, increases student engagement and motivation, and reduces learning time, allowing for more flexible scheduling, increased retention, and lower costs (Cavalier & Klein, 1998; King and Crown, 1997).

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Students can investigate, analyze, and develop their knowledge using computer-based interactive courseware, according to Funkhouser (2003). Students who get computer-assisted geometry teaching comprehend geometry topics better than students who receive traditional geometry instruction. According to Ploger, Klinger, and Rooney (1997), most mathematical notions may be reinterpreted and simulated using the software.

As a result, students' understanding of mathematical topics might become more concrete, clear, and motivating. It is critical to encourage learners to explain what is going on, maintain attentive listening, reply to what they have heard with appropriate remarks, questions, or actions, and utilize discourse to organize ideas via stimulating communication skills (Bragg, 2006). Studies on children show that computer interactions that share users' interests are more motivating (Cordova & Lepper, 1996). Pierfy (1977) discovered that simulations and interactive courseware result in stronger long-term memory than traditional classroom training. The study further revealed that interactive courseware helped students retain the learning instructions. Additionally, these interactive courses increased student engagement and enhanced their interests in learning besides changing their attitudes towards learning. However, like any other activity, interactive courseware requires interesting and dynamic to ensure the students remain motivated.

METHODOLOGY

Research Design

There was an experimental and a control group in this quasi-experimental study. The experimental group received interactive geometry software and teacher instruction, while the control group received only instructor-led instruction. Before the study, a pre-study test was conducted. After the study, a post-study test was done to see a significant difference in mean scores between students who got CAI instruction and those who received traditional instruction.

Participants

The study's target group was junior high school (JHS) students in private and public schools in the Asokore Mampong Municipality. The municipality comprises 36 Private and 38 Public JHSs. However, the accessible population was three schools where computers were available and accessible for students' use (Asokore Mampong Municipal Education coordinators' report, 2015). Out of these, two schools, S.O.S. Hermann Gmeiner School and Brilliant International School were purposively selected due to their similar academic ratings and availability of computer laboratories that give each student access to a computer.

Purposive sampling is where the sample is taken from a group of individuals/subjects specially qualified (i.e., will provide the information needed) based on the researcher's judgment for the study. Trochim (2006) remarked that purposive sampling is employed because of the special characteristics of the schools in facilitating the purpose of the research. Purposive sampling does not use a random approach to select the sample unit. Participants are chosen for the study because

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of their unique qualities or because they meet particular criteria that are not randomly distributed throughout the universe. Nonetheless, they are typical, meaning they exhibit the majority of the study's characteristics.

JHS. 2 was specifically used in this study. According to the study's design, all students in the specified classes took part in the study's study. Hermann Gmeiner School had 30 students (18 males and 12 females), whereas the Brilliant International School had 30 kids (16 males and 14 females). Hence, the total sample size for the study was 60.

The students from S.O.S. Hermann Gmeiner School was the experimental group where interactive courseware was introduced, while the students from Brilliant International School were the control group where traditional instructional methods were used.

Research Instruments

A pre-study accomplishment exam (PAT) was created and delivered to the students to ascertain the baseline level. Plane geometry with angles, triangles, and parallel lines was among the test items on the accomplishment test. None of the participating groups had previously treated these topics. The pre-study achievement test consisted of 20 multiple-choice questions. A questionnaire was administered to measure participants' attitudes from both the experimental group towards computers and the control group's attitudes towards traditional instructional methods. The experimental group used previously acquired computer skills to navigate the courseware (Figure 3, Figure 4 shows the target group of the courseware, which is preceded by the requirement and duration page, which is figure 5). From there, the objectives of the tutorial are displayed to the students in Figure 6. Students are instructed to raise their hands when they have a question. Figures 7 and 8 are the help and menu pages, respectively. Figures 9 and 10 introduce the students to the first topic of the tutorial. The questions provided for response are in Figure 11. If the student makes a wrong choice, they are made to go through the entire presentation again. If the student completes the correct choice, they are directed to the end of the presentation.

Intervention

The interactive courseware (Intervention) was developed with Microsoft PowerPoint 2013, and it was tested by two mathematics teachers from the selected schools. The interactive courseware is a tutorial package that presents the content, after which a series of questions are presented to the students to consolidate their learning. According to Alessi and Trollip (2000), educational multimedia applications should introduce the software in any instance after the application is used as a learning tool. In this case, the learner should have control over the program and the presentation of information with help features to guide the student throughout the program. All these features were provided in the courseware to make it user-friendly.

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Data Collection

The experiment had two treatment groups: the control group, which received standard teaching, and the experimental group, CAI. Other computer capabilities such as the internet and games were disabled for the experimental group, so they could only use the interactive courseware. The experimental group's independent variable was the use of ICT-based interactive courseware. The pre-test was given to both the control and experimental groups. To eliminate bias, the test was carried out to see if both participants had the same comprehension of the subject (algebra). During the experiment period, the control was taught by question and answer methods, related topics, and basic concepts (algebra). The researcher used two weeks for the intervention. Both the experimental and control group had one-hour lessons for five days. See Appendix G for lesson notes used for the interventions. Immediately after the study, a post-study test was administered to all the participants. The post-study test was intended to determine whether a difference existed compared to the baseline. The results from the post-study trial were scored accurately and input in SPSS software. Analysis of the data using the software was done to create tables and results.

Analysis of Data

Various statistical approaches were used in the research. Hypotheses 1, 2, and 3 were assessed using data from both research groups in a paired sample t-test, with descriptive statistics employed to explain the data.

RESULTS

The study's aimed to determine the distinction between the two groups before and after the intervention was administered. Analysis of the data obtained in the study is presented in line with the hypothesis raised and tested.

Hypothesis 1

H_o: No difference exists between the mean scores of the students taught angles in mathematics using ICT-based interactive courseware and those taught using the traditional instructional approach.

This hypothesis was tested using a paired t-test with an alpha level of 0.05.
The means and standard deviations of the experimental and control groups' pre- and post-study test achievement scores were calculated for this hypothesis. Tables 2 and 3 summarize the findings.

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Table 2 Mean and Standard deviation of Pre-Test Achievement Scores

	Pre-Test		Post-test	
Groups	Experimental	Control	Experimental	Control
Mean	64.23	64.20	76.53	66.10
N	30	30	30	30
Std. Deviation	13.713	14.133	8.374	13.066

The result shows that the mean pre-study test scores for the groups were 64.23 and 64.20, respectively. Both groups had standard deviations of 13.713 and 14.133, respectively. The control group had greater pre-study test achievement scores than the experimental group. Hence, the pre-study test results are the same for both study groups.

Table 3 shows that the mean post-test t scores for both research groups were 76.53 and 66.10, respectively. Both groups had standard deviations of 8.374 and 13.066, respectively.
To determine if the differences between the two groups in the pre-test and post-test were significant, the paired t-test was employed.

Table 3 Paired Sample T-test Scores on Pre-Test Achievement Scores

Groups	Mean	Std. Deviation	t-value	N	df	p
Experimental	64.23	13.713	0.092	30	29	0.928*
Control	64.20	14.133		30	29	

According to Table 3, the experimental group's mean pre-test geometry score (M= 64.23, SD=13.713) was somewhat higher than the control group's (M=64.20, SD=14.133). When the paired sample t-test was used, there was no statistically significant difference in pre-test score performance in geometry for the two groups, t (29) = 0.092, p > 0.05, and p = 0.928.

Table 4 shows a paired sample t-test for the post-test of the experimental and control groups.

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Table 4 Paired Sample T-test Scores on Post-Test Achievement Scores

Groups	Mean	Std. Deviation	t-value	N	df	p
Experimental	76.53	8.374	0.092	30	29	0.000*
Control	66.10	13.066		30	29	

Table 4 shows that the experimental group's mean post-study test score in geometry (M=76.53, SD=8.374) was somewhat higher than the control group's (M=66.10, SD=13.066), t (29) = 0.092, p = 0.000, p 0.05. As a result, there was a significant difference in post-study test achievement scores, and the experimental group preferred the difference.

Hypothesis 2

H_o: ***There was no significant difference noted between the mean scores of the high achievers of the experimental and control groups.***
The two groups were separated into two halves for this hypothesis. The test scores are shown in Tables 5 and 6.

Table 5 Paired Sample T-test Scores on Pre-Test of High Achievers of both Groups.

Groups	Mean	Std. Deviation	t-value	N	df	p
Experimental	76.20	5.240	0.174	15	14	0.865*
Control	76.13	5.083		15	14	

The mean and standard deviation score of the pre-study test in the geometry of the better achievers in the experimental group (M=76.20, SD=5.240) is somewhat higher but not substantially different from that of the control group (M=76.13, SD=5.083), t (14) = 0.174, p = 0.865, as shown in Table 5.

The post-study test scores in the experimental and control groups of high achievers were compared and displayed in Table 6.

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Table 6 Paired Sample T-test Scores on Post-Test of High Achievers

Groups	Mean	Std. Deviation	t-value	N	df	p
Experimental	82.53	4.138	8.783	15	14	0.000*
Control	76.53	5.986		15	14	

The results showed that the experimental group's mean geometry test score (M= 82.53, SD=4.138) was substantially higher than the control group's mean geometry test score (M=76.53, SD=5.986), t (14) = 8.783, p = 0.000, p 0.05. The post-test achievement scores of the two groups were found to differ significantly.
This shows that high-achieving students taught using interactive courseware outperformed a control group of students taught using the traditional technique.

Hypothesis 3

H_o: There is no significant difference between the mean scores of the low achievers of the experimental group and control groups.

The effect of the pre-test on the low achievers was evaluated using a paired sampling t-test. Tables 7 and 8 summarize the findings.

Table 7 Paired Sample T-test Scores on Pre-Test of Low Achievers

Groups	Mean	Std. Deviation	t-value	N	df	p
Experimental	52.27	7.43	0.000	15	14	1.000*
Control	52.27	9.10		15	14	

Table 7 shows that the experimental group's mean geometry pre-test scores (M= 52.27, SD=7.33) were somewhat higher than the control group's (M= 52.27, SD=9.10), t (14) = 0.000, p = 1.000, p > 0.05. As a result, there was no significant difference in pre-test results between the two groups.

The impact of the intervention on respondent achievement scores in geometry was determined using a paired sample t-test, and the results are shown below.

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Table 8 Paired Sample T-test Scores on Post –Test of Low Achievers

Groups	Mean	Std. Deviation	t-value	N	df	p
Experimental	70.53	7.140	4.964	15	14	0.000*
Control	55.67	9.194		15	14	

Table 8 shows that the mean, standard score of the post-study test in the geometry of the experimental group's poor achievers (M= 70.00, SD=7.461) was greater than that of the control group's low achievers (M=56.00, SD=8.206), t (30) = 4.488, p = 0.000, p 0.05. As a result, both groups' post-study test accomplishment results differed significantly, favoring the experimental group's poor achievers.

Table 9 shows the attitudes of the two groups toward teaching tactics based on responses to objects.

Table 9 Summary of Responses to the Questionnaire.

	Items	Responds			
		Experimental		Control	
		Yes (%)	No (%)	Yes (%)	No (%)
1	Did you find the lesson exciting?	24 (80)	6 (20)	12 (40)	18 (60)
2	Were you happy with the lessons?	26 (86.7)	4 (13.3)	10 (33.3)	20 (66.7)
3	Do you prefer to use the same learning method in studying geometry?	21 (70)	9 (30)	16 (53.3)	14 (46.7)

Table 9 shows that 24 (80%) and 6 (20%) experimental groups answered yes and no, respectively, to find the lesson exciting. Response from the control group showed that 12 (40%) and 18 (60%) stated that the lesson was exciting, respectively. With item two (2) on the question, experimental group 24 (86.7%) and 4 (13.3%) indicated they were happy with the lesson, whiles 10 (33%) and 20 (66.7%) responded yes and no respectively for the control group. 21 (70%) and 9 (30%) answered yes and no, respectively, for the experimental group on item three (3) and 16 (53.3%) and 14 (46.7%) indicated yes and no responds respectively for the control group.

DISCUSSION

The study used a quasi-experimental design to investigate the effectiveness of CAI in enhancing students' geometry performance. The study's goal was to see if interactive ICT-based courseware could assist students in improving their academic performance in geometry. Two schools in the Asokore Mampong Municipal were chosen at random, and their form 2 students were recruited as

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study subjects. Four hypotheses were tested to see if there were any significant differences in the mean scores of students in both research groups. Only thirty (30) Form two (2) pupils from each school were randomly selected as study participants.

These findings support Cotton's (1997), Goode's (1988), and Harrison and Van Devender's (1988) research (1993). They have argued that Computer Assisted Instruction is the best way to learn but must be supported by the traditional technique. Kulik (2003) investigated the "Effects of Using Instructional Technology in Colleges and Universities" in a similar study. He concluded that when students were taught using computer-based interactive courseware, they performed well.

The result from table 7 supports the studies of Basturk (2005), Cradler *et al.* (2002), Edwards *et al*. (1975), Tabassum (2004) that students who are exposed to computer-based learning. Exhibit good performance in their test scores.

This result indicates that low achievers who used ICT-based interactive courseware to learn geometry showed better results than those in the control group. The result from Table 11 supports the studie of Wright, and Hildreth (1997) that students showed better results in learning with interactive courseware. Again in their findings, traditional methods of teaching may need a change of perspective. The overall observation is the interactive courseware is an effective tool in meeting the unique learning needs of different students, especially those with impaired language skills. Such assertions further affirm the findings of this study.

Furthermore, previous studies were done by Haugland and Ruiz (2002), exploring the effectiveness of computer-aided instruction in learning mathematics, found that the use of CAI is more beneficial in helping to understand than studying in a conventional learning environment. Therefore, the study can conclusively say that CAI helps to improve students understanding of geometry.

The researcher further went on to measure whether students' had positive or negative attitudes using a questionnaire. One of the most important factors in the teaching and learning process is students' attitudes toward a lesson. After implementing the intervention, the researcher issued a questionnaire containing three items that requested students to respond 'Yes' or 'No' whether positively or negatively impacted their behavior.

The experimental group was more enthusiastic about learning geometry through interactive courseware than the control group, taught using the traditional observational method. The findings support Smith, Caputi, and Rawstorne's (2000), Yushau's (2006), Maio and Haddock's (2010), and Tondeur, Valcke and Van Braak (2008) findings that students can engage with computers without the teacher's help.

Learning is optimized when the student can work independently, especially when actively participating in tasks. Students using CAI get immediate feedback which enhances their understanding. Students can master easier topics before they can cover more complex topics.

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Students also access tutorials that provide additional assistance and feedback, supporting better learning when using CAI.

FINDINGS

The study's main findings were:

- There was no statistically significant difference in the pre-test score performance in geometry for the two groups.
- Students taught using interactive courseware as an intervention showed better achievement in geometry than those taught by the traditional method.
- Performance in geometry for high achievers in both groups did not differ significantly.
- High achieving students taught using interactive courseware exhibited much better achievement and differed significantly from the high achieving students taught by the traditional method.
- Performance in geometry for low achievers in both experimental and control did not differ significantly.
- Low-achieving groups taught through interactive courseware performed better compared to groups who were taught through traditional techniques.
- The study also found that the experimental group formed a more positive attitude toward using interactive courseware to learn geometry than the standard group.

CONCLUSIONS AND IMPLICATIONS

The study revealed that mathematics learning in most schools is mostly based on textbooks resulting in negative attitudes towards the subject. This finding implies that using concrete and activity-oriented methods of the instructional medium encourages students to be active, exhibit in-depth understanding, and develop positive attitudes towards learning. Students are increasingly engaged in the learning process with these platforms, increasing their interest in learning and boosting their confidence in the classroom, especially when interactive computer technology is used.

Furthermore, interactive platforms that provide immediate feedback allow students to follow their progress easily and quickly, giving them the opportunity to identify and rectify their mistakes while also building on their prior knowledge. This frequent assessment and instant feedback arrangement has been shown to improve learning outcomes. Indeed, as the findings of this study indicate, students who used interactive courseware performed better than those who used traditional learning methods, with higher performance improvements among lower achievers. The students are increasingly attentive, have heightened interest, and continuously engage with the interactive courseware throughout their lessons. Based on those mentioned above, this paper concludes that students learned faster, enjoyed their classes more, and significantly enhanced their academic performance by employing interactive courseware.

Recommendations

According to the findings, the group of students who were taught using conventional methods did better than those who were taught using ICT-based courseware with the support of teachers. Students should be encouraged to pursue their computing interests and talents. Teachers are also advised to use real-world scenarios to minimize the abstract constructs present in the subject. The usage of interactive courseware as an instructional medium in the classroom should not be implemented in isolation but should be implemented with the help of a teacher. Teachers of different subject areas should be trained on integrating computers in teaching the various subject areas and integrating interactive courseware in the teaching.

Only two schools in the Asokore Mampong Municipal were chosen for the study. The study should include other deprived schools at various grade levels and larger sample size based on the findings. There is a need to undertake more studies on interactive courseware in other subject areas, especially English language, integrated science, and Social studies. The reviewed literature revealed that mathematics learning in most schools is mostly based on textbooks resulting in negative attitudes towards the subject. There is a need to carry out more studies on improving students' attitudes towards mathematics.

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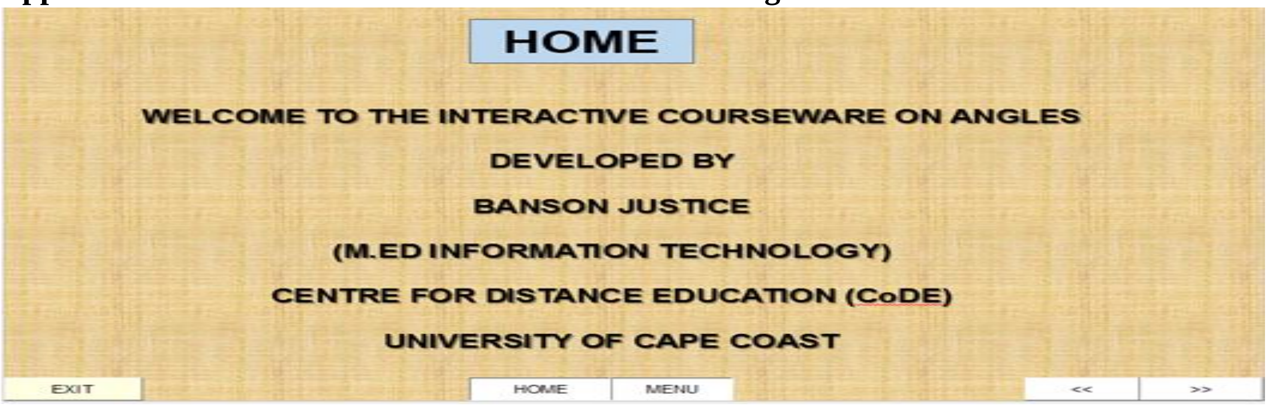
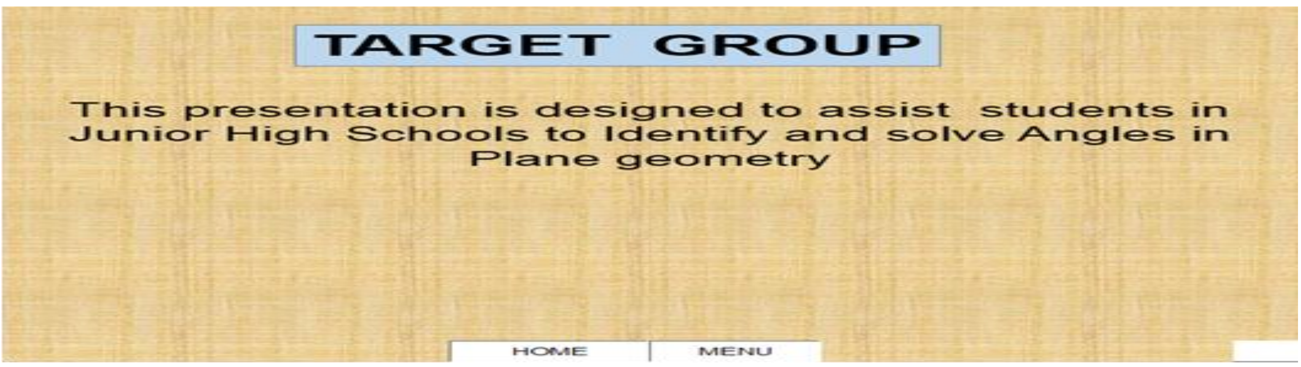
Appendix

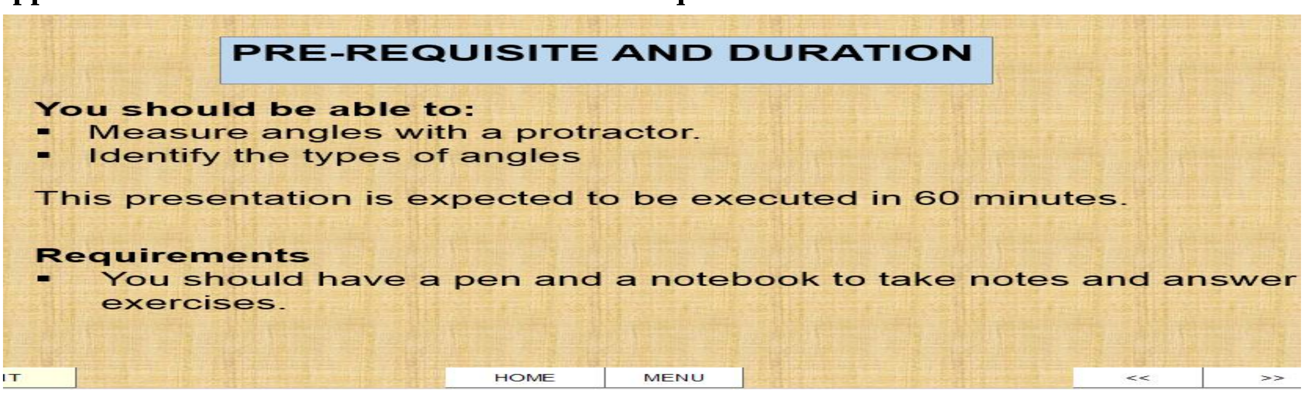
Appendix A: A Screenshot of The Courseware Home Page



Appendix B: A Screenshot of The Courseware Target Group



Appendix C: A Screenshot of The Courseware Requirement and duration



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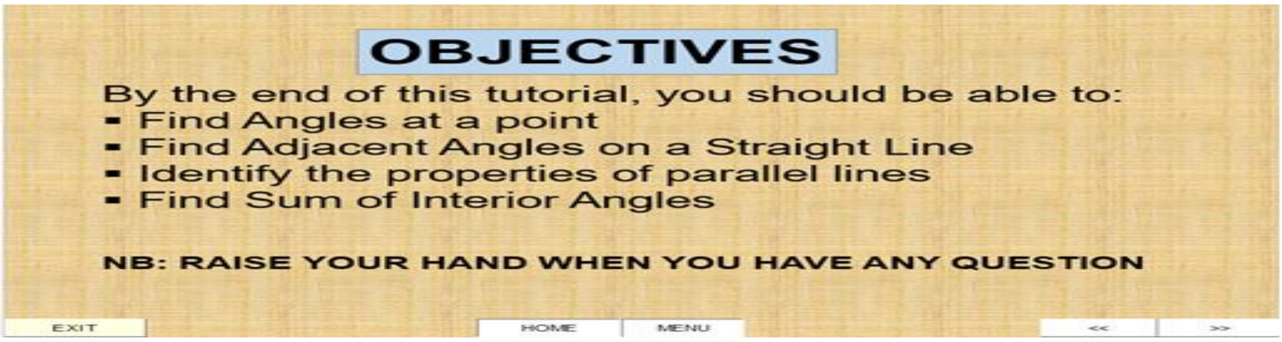
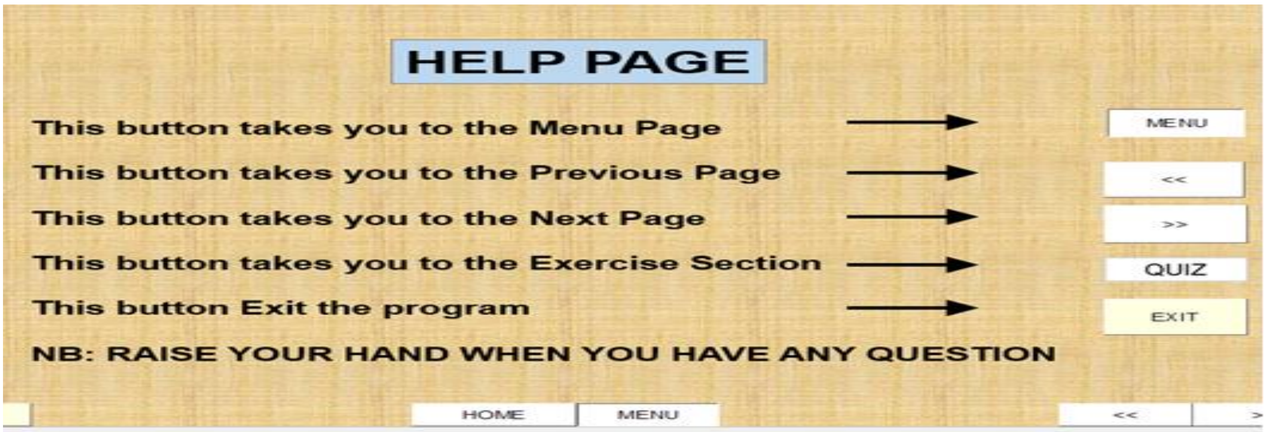
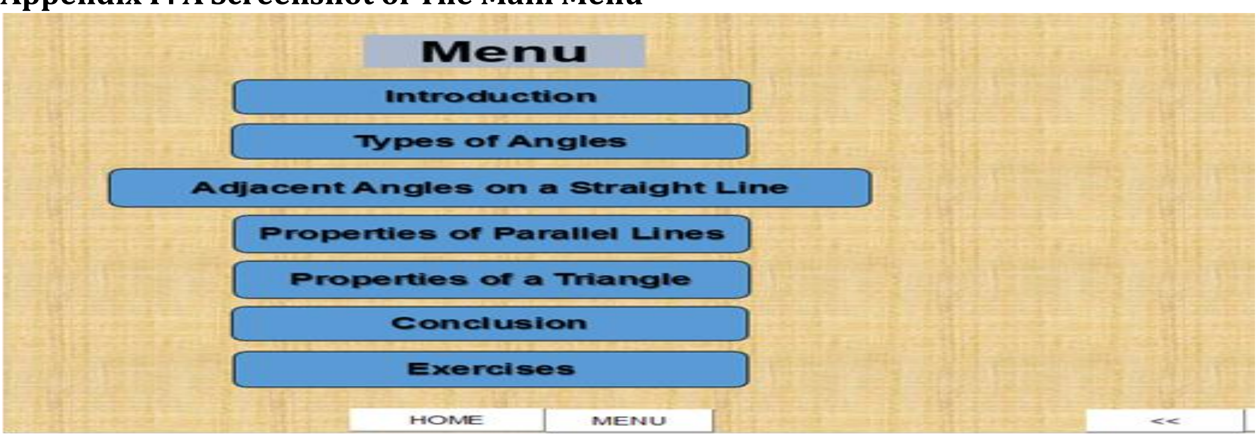
Appendix D: A Screenshot of The Courseware Objectives



Appendix E: A Screenshot of The Courseware Help page



Appendix F: A Screenshot of The Main Menu



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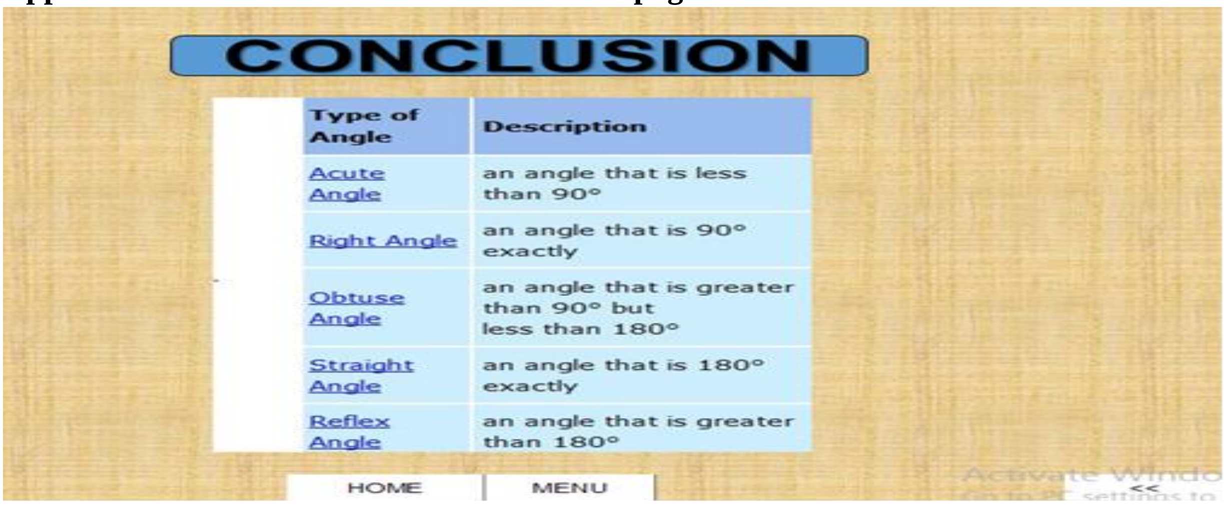
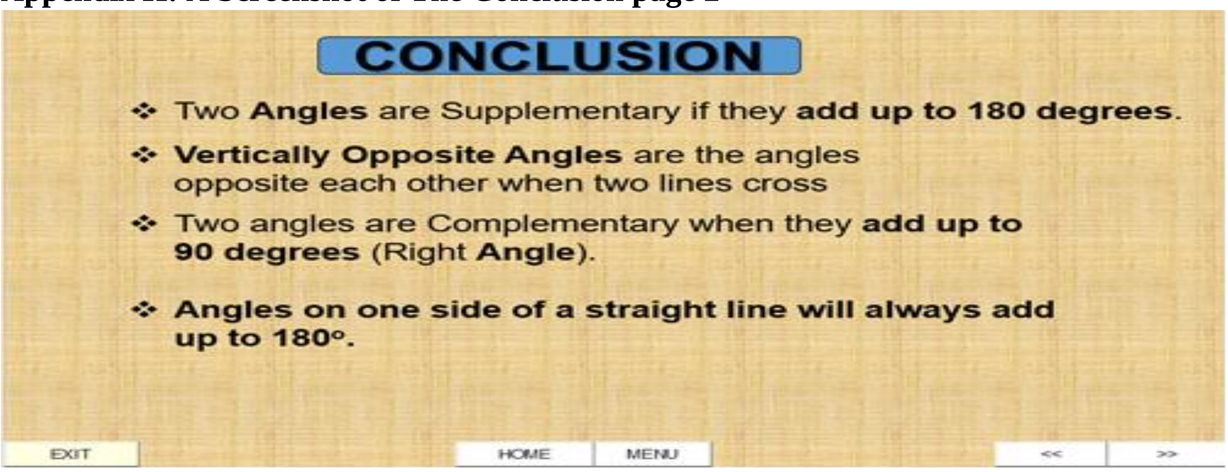
Appendix G: A Screenshot of The Conclusion page



Appendix H: A Screenshot of The Conclusion page 2



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