An Examination of Computer -Based Instructions (CBT) in the Teaching of Quadratic Functions and Equations in Senior High Schools in Ghana; The Case of Dwamena Akenten and Namong Senior High Schools

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Abstract: **The study examined the use of Computer -Based Instructions (CBT) in the teaching of quadratic functions and equations in Senior High Schools in Kumasi-Ghana, specifically Dwamena Akenten and Namong Senior High Schools respectively using quasi-experimental approach.The population of the study was 2070 and a stratified method of sampling was used to sample 80 students for experimental and control exercises. The students were pre-tested to ascertain their equivalence in achievement and post-tested after the interventions. The experimental group was ahead of the control group in achievement after comparing their post-test means. This led to the rejection of the null hypothesis which said that, "there is no significant difference in the achievement levels of the two groups". The findings further revealed that students completed three times more exercises compared to what would have been expected with traditional worksheets. Moreover, teachers found that the activity was easy to administer and Control.**

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The study concluded that the use of the ICT tools has some comparative advantage over the traditional teacher presentation. The researcher thus recommended that Computer –Based Instructions should be inculcated into the teaching and learning of Mathematics to improve upon students' achievement levels in our schools.

I. INTRODUCTION

Background to the Study

It is difficult and may be impossible to imagine future learning environments that are not supported in one way or the other, by Information and Communication Technologies (ICTs). Educational Software and for that matter Computer-Based Instruction (CBI) has existed for over four decades, but it was not widely used until the advent of the personal computer. The use of Computer –Based Instructions in the teaching sphere gained prominence following the introduction of networked personal computers within the late 1980s (Vululleh, 2018).

When one looks at the current widespread diffusion and use of ICT in modern societies, especially by the youth, the so-called digital generation, then it should be clear that ICT will affect the complete learning process of today and in the future. There is also a common belief that ICT can and will empower teachers and learners, transforming teaching and learning processes from being highly teacher-dominated to student-centred. This transformation will result in increased learning gains for students, creating and allowing for opportunities for learners to develop their creativity, problem solving abilities, informational reasoning skills, communicational skills, and other higher-order thinking skills.

Teachers can harness the positive vibes of CBI in the form of; less drudgery and repetition, tremendous ease in updating instructional materials, more accurate appraisal and documentation of student progress, as well as adequate time to work directly with students (Ansong et al., 2017).

With increasing advances in computer technology, computer-based instruction (CBI) is now seen by many as a method of providing relevant instruction for large numbers of students. Learning with, for instance, mobile game technologies can indeed make learning more pleasant and more effective. Naismith, Lonsdale, Vavoula and Sharples (2004) reported on a Mathematics video game that used Nintendo Game Boy Advance system to supplement traditional curricula and teaching methods. Drills in addition and subtraction were presented as a game with advanced scoring and record keeping, character creation and variable difficulty levels.

Since no nation wants to be left behind this crusade, the Government of Ghana is committed to pursuing an ICT for Accelerated Development (Republic of Ghana [ICT4AD], 2003) Vision aimed at improving the quality of life of the people of Ghana by significantly enriching their social,

economic and cultural well-being. This can be achieved through the rapid development and modernization of the economy and society using information and communication technologies as the main engine for accelerated and sustainable economic and social development. The main mission of the Ghana ICT AD Vision is: to transform Ghana into an information-rich, knowledge-based and technology-driven high-income economy and society.

The major problem in the teaching and learning of Mathematics in Ghana is that most students perceive the subject as a difficult one. Part of this attribution could be likened to the teaching methods used in teaching the subject. To this end, the researcher asks ‘’To what extent is the use of Computer-Based Instruction (CBT) suitable in the teaching and learning of Mathematics in Senior High Schools in Ghana?’’

Computer-Based Instruction (CBI) has the potential to improve upon learning and satisfaction. Al-Adwan et al., (2013) posited that CBI has the tendency of producing tremendous consistent learning and high knowledge retention especially in andragogical lessons . Learner satisfaction may be enhanced when employees who have prior knowledge of a topic could use CBI to bypass already mastered material, and acquire knowledge on a schedule of their own choice, CBI may be found to deliver instruction more economically than classroom lecture.

Key Words: Computer-Based Instruction (CBI), Computer-Based Tutorials(CBT), Dwamena Akenten SHS, Namong SHS, Ghana etc.

II. REVIEW OF EXTANT LITERATURE

The review of extant literature embodies conceptual and empirical reviews respectively.

2.1 Educational Software

The days of boring classroom lectures and lengthy textbooks have met their match in computer forms of training, instruction or tutorial. Educational software are the alternative methods of instruction by which instruction, knowledge or information can be presented to learners using computer and any other ICT tool without necessarily having an instructor or teacher on sight.

The emergence of Educational Technology (ET) has been essentially regarded as a major revolution in the educational system especially in Computer-Based Instructions in academic tutelage (Ansong et al., 2017). The impact is akin to the changes brought about by other educational revolutions such as: shifting the task of educating children from parents to teachers, or rather from home to school; the adoption of the written word as a tool of education; the invention and widespread of printing material such as books (The Fourth Revolution, 1972). In the same vein, one can argue that the invention of computers and the World Wide Web is another revolution inside the educational technological revolution. With this, the faces of all educational systems have changed forever.

Some others could not find any significant difference between Computer-Aided Instruction (CAI) and Traditional Instruction (TI). (Alacapinar, 2003; Bayraktar, 2001; Cetin, 2007).

2.2 History of Educational Software (ES)

The use of CBI, CBT, CAI and other variant forms of computer-based programs are not new training or learning concepts. Instructions given by computers date back as far as the 1970's, when the Chrysler Corporation launched computer-controlled interactive video discs to teach skills to assembly line workers (Vululleh, 2018). With CBT, training is provided through the use of a computer and software, which guides a learner through an instructional program (Almarabeh,T., 2014). In the words of Al-Adwan et al., (2013) earliest studies attempted to automate instruction were initiated by Sidney Pressley in the early 1900s and by B. F. Skinner in 1954. Both Pressley and Skinner developed techniques of administering instructional materials to students by means of teaching machines or programmed text. The programmed text and teaching machines were very limited in their ability to adapt to individual differences among students or to provide a stimulating, responsive environment for students. The obvious limitations of these devices prompted investigation of applying computers to instructional tasks.

The use of random-access audio, playback/record capability, and random-access image projectors, all under program control, accompanied more complete instructional systems (Clark et al.,2016). During the 1960s the University of Illinois engaged in a computer-assisted project, PLATO (Programmed Logic for Automatic Teaching Operations), in connection with Control Data Corporation and the National Science Foundation (Vululleh, 2018; Ansong et al., 2017; Al-Adwan et al., 2013). PLATO was one of the largest and perhaps most sophisticated computer systems designed for education. This system supported approximately 1000 terminals at different locations within the United States and abroad and provided each site with access to a central library of lessons (Vululleh, 2018; Ansong et al., 2017). In 1972, the Mitre Corporation of Bedford, Massachusetts and C. Victor Bunderson and associates at Brigham Young University developed the Time-Shared, Interactive, Computer-Controlled, Information Television (TICCIT).

2.3 Summary of Related Literature

Educational software are the alternative methods of instruction by which instruction, knowledge or information can be presented to learners using computer and any other Information and Communication Technology (ICT) tool without necessarily having an instructor or teacher on sight. Today's students are maturing with visual devices like television, video, computer and Internet and the purpose of using computers in the teaching and learning of Mathematics

is for the "enrichment and improvement of the conditions in which human beings learn and teach".

Moreover, the interactive aspect and the instant feedback provided by the CBT are seen to engage the learners in active thought and thereby increase knowledge retention. One of the factors that limit student creativity in Mathematics is the student's inability to recognize and connect mathematical structures and objects in different situations. In this respect, computers have the ability to help students uncover shared and unshared patterns of a class of mathematical objects. Looking at the cost effectiveness, by customizing CBT program to focus only on what learners need to know or learn, the training time and cost of presenting a body of knowledge to students can be reduced significantly as compared to the time used in the traditional classroom setting. In view of that, teachers and especially Mathematics teachers should try to turn most of classroom presentations into CBTs and also do everything within their power to inculcate in learners the inclination to develop strategies in the process of solving problems as prescribed by the authorities in the field.

III. METHODOLOGY

Synopsis of research methodology encapsulates research design, population, sampling and sampling procedures, data collection and analysis etc

3.1 Research Design

The research design used for this study was the quasi-experimental. The rationale behind choosing this particular design was that the research sought to find out the achievement levels of students in connection with the use of CBI and its variants as against the traditional method of teaching or teacher presentation in the teaching of Mathematics. According to Gribbons and Herman (1997), experimental designs are especially useful in addressing evaluation questions about the effectiveness and impact of a programme. Emphasizing the use of comparative data as context for interpreting findings, experimental designs increase our confidence that observed outcomes are the result of a given programme or innovation instead of a function of extraneous variables or events. Among the experimental designs is quasi-experimental design which uses the pre-test ─ post-test design.

Quasi-experimental designs are used when randomization is impossible and/or impractical. They are typically easier to set up than true experimental design‟s random assignment of subjects. Additionally, utilizing quasi-experimental designs minimize threats to external validity as natural environments do not suffer the same problems of artificiality as compared to a well-controlled laboratory setting. Since quasi-experiments are natural experiments, findings in one may be applied to other subjects and settings, allowing for some generalization to be made about population. Also, this experimentation method is efficient in longitudinal research that involves longer time periods which can be followed up in different environments.

3.2 Population

The population for the research was students from the Dwamena Akenten and Namong SHSs because these two schools have almost the same student population of 2070 . Using the stratified method of sampling a sample frame of eighty (80) students was selected from the two schools.

3.3 Sample and Sampling Procedure

The stratified method of sampling was used to ensure that each group; Experimental and Control group had equal number of boys and girls with similar abilities although performance as regards sex was not compared. After the stratification, the simple random sampling method was used to select students for each of the two groups. Armstrong et al.,(2020) posits that this method of sampling is apt since equal researched unit has equal chance of selection. This method of sampling was used because it is the best and the most scientific way of getting subjects from a population. Again, it ensured that each subject had equal and independent chance of being chosen from the lot. The Experimental and Control groups were made up of 40 students each. Numbered ballot papers were made with numbers 1 up to 80 and those who picked the papers numbered 1–40 were selected from each school for the research.

3.4 Assessment and Data Collection

At the end of the two-week period, there was a quiz which was the post-test. The quiz consisted of 20 multiple choice test items from the various subtopics of the main topic in the curriculum. This test was earlier given to them as the pre-test before the beginning of the study.

Each correctly answered test item was awarded a score of 5. The students were allowed to use hand-held calculators. Their achievement was made known to them immediately at the end of the test. The achievement test was a teacher made one and the same as the one used in the pre-test which was checked by a content expert to ensure it was good for the intended purpose.

3.5 Analysis of Data

The data that were collected using the teacher-made multiple-choice test items was presented in frequencies and percentages. It was analysed using the independent t-test to find out if there were any significant differences in the academic achievements of the two groups using the SPSS software. The students were asked at the end of the test to find out if they were happy to use the computer tutorial.

IV. ANALYSIS OF RESULTS

4.1 Background Information of Subjects

The two schools; Dwamena Akenten and Namong SHSs which are both located in the Offinso Municipal have students

who are either in the boarding house or are day students. (Table 1)

Table 1 describes the distribution of the students as regards their status. It shows that a total of 80 students were used in the study. Out of this total, 40 of them were from Dwamena Akenten SHS while the remaining 40 were also from Namong SHS. Thirty of the respondents from Dwamena Akenten were in the boarding house while 10 were day students representing 37.50% and 12.50% respectively. With regard to the students from Namong SHS, 28 were in the boarding house while 12 of them were day students representing 35% and 15% respectively.

Table 1: Distribution of Students by School and Status

Name of School	No. of Students	Status			
		Boarding	Percent (%)	Day	Percent (%)
Dwamena Akenten SHS	40	30	37.50	10	12.50
Namong SHS	40	28	35.00	12	15.00
Total	80	58	72.50	22	27.50

Source: Author's construct (2012)

Table 2 illustrates that 37.5% each of researched the researched schools are males and 12.5% each of the researched schools are females.

Table 2: Distribution of Gender of Respondents by School and Group

Name of School	Group	Male	Female
Dwamena Akenten SHS	Experimental	30 (37.5%)	10(12.5%)
Namong SHS	Control	30(37.5%)	10(12.5%)
Total		60 (75.0%)	20 (25.0%)

Source: Authors' construct (2012)

An average of 70% of the respondents ages between 17-18 whilst the 30% represent 15-16 as illustrated in table 3.

Table 3: Distribution of Age of Respondents by Group

Age (Range)	Experimental	Control	Percent (%)
15 – 16	14	10	30
17 – 18	26	30	70
Total	40	40	100

Source: Authors' construct (2012)

Research Question1

Is there any difference in the achievement level of students‟ in the Experimental group before and after the intervention?

Table 4: Descriptive Statistics on the Achievement of the Experimental Group

Group	N	Pre-test		Post-test		MD
		Mean	SD	Mean	SD	
Experimental	40	12.35	2.537	14.70	1.856	2.35

Table 5: Paired Sample t-test on the Achievement of the Experimental Group

	MD	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1 Post-test – Pre-test	2.350	0.834	17.830	39	0.000

4.2 Discussion of Findings

From the calculated eta squared value of 0.89, I concluded that there was a large effect with a substantial difference in the post-test and pre-test mean scores within the Experimental group.

After analyzing the data collected on the Experimental group based on the research question 1, it could clearly be seen that CBI post-test scores were a bit on the high side. This significant improvement on the scores of those students in the Experimental group using CBI was also shown in their post-test mean score which was also higher than their pre-test mean score. An important factor that might have contributed to the positive impact was due to the tutorials. This was so because it provided a learning environment that promoted both independent and interdependent activities with cognitive as 54 well as psychosocial support. These students had the opportunity to discuss among themselves anything on the CBT that seemed to be a bit difficult. This goes to affirm the assertion made by Ansong et al., (2017), in their study which says that, CBI provide a learning environment that promotes both independent and interdependent activities with cognitive as well as psychosocial support because students generally have two basic intrinsic motivating drives of autonomy and affiliation, and that the computer can retain responses to stimuli in its memory bank, making it possible to reconstruct the actual learning sequence of any given student.

I believe that this positive mean difference of 2.35 was as a result of the usage of the CBI as well as my presence which was an indication that the best use of CBL is when it is used as supplement to teacher-directed instruction. Again, I can also attribute this improvement to the fact that the students‟ interest in using the courseware was very high as regards some comments made by most of the students wanting to have their lectures in CBIs and its variants.

V.CONCLUSION

5.1 Summary of Findings

From all the findings I can say that the Experimental or CBI group did well. In view of this, the CBI and its variants can be used alongside the conventional teacher presentation in this

era of technology in the classroom to enhance students" performance and achievement in Mathematics. Moreover, the use of technology-enhanced instruction has increased and the methods have been proven to be effective. I would also attribute the superior performance of the Experimental group over the Control group to the fact that the instructional method of the former was a blend of both the traditional teacher presentation and the computer lesson delivery.

Again, since the CBT was left on the computers, the Experimental group had the opportunity reviewing what they went through in the previous lesson at their own pace which was not so for the Control group although there was some sort of review whenever a new sub-topic was to be treated. Besides, the Experimental group had the chance of getting an immediate and prompt response to the questions provided on the courseware which could also serve as a source of motivation to whet their desire to know or learn more.

5.2 Conclusion

Against the backdrop of the findings, it could be concluded that the use of Computer- Based Instructions in the teaching and learning of Mathematics, be it core or elective enhances understanding and arouses students' interest.

VI. RECOMMENDATIONS

Based on the results and findings of this study, I wish to make these recommendations:

1. The Ghana Education Service and the ministry in charge of education and youth development should try to ensure that the standards set for the purchase of the various ICT materials for schools are adhered to so that importers do not bring in just any computers for the schools to buy.
2. The authorities should also put in place the needed facilities and motivation to attract all subject teachers to use the computers for the preparation and delivery of lessons to make the ICT policy of the nation achievable.
3. I would also like to encourage GES and the Ministry of Education to make funds available to the various schools so that teachers of Mathematics especially can develop simple CBI and its variants to be used in the classrooms to enhance teaching and learning processes.
4. Moreover, students who are actually not good at Mathematics could be given some extra tuition through the use of ICT tools to motivate them and to reinforce whatever has been taught.
5. Finally, authorities of the various schools should try to ensure that computers that are being used in the schools are housed under conducive environments such as air-conditioned rooms to cool down the machines since they generate a lot of heat which inadvertently affect the lives of the computers. Although most of these computers are slightly used ones, the provision of dust-proof rooms would reduce the influx of dust settling on the computers in order to prolong their lives.

REFERENCES

[1] Aberson, C. L., Berger, D. E., Healy, M. R., & Romero, V. L. (2002). An interactive tutorial for teaching statistical power. Journal of Statistics Education, 10(3), 15-21.

[2] Adler, J., Ball, D., Krainer, K., Lin, F. L., & Novotna, J. (2005). Reflections on an emerging field: Researching mathematics teacher education. Educational Studies in Mathematics, 60(3), 359-381

[3] Alacapinar, F. G. (2003). The effect of traditional education and education via computer on the students' gain. Eurasian Journal of Educational Research, Winter, 10,40-45.

[4] Al-Adwan,A.,Al-Adwan,A.,&Smedley,J.(2013).Exploringstudents'acceptanceofe-learningusing technology acceptance model in Jordanian universities. International Journal of Education and Development Using Information and Communication Technology, 9(2), 4–18.

[5] Almarabeh, T. (2014). Students' perceptions of e-learning at the University of Jordan. International Journal of Emerging Technologies in Learning, 9(3), 31–35. doi:10.3991/ijet.v9i3.3347

[6] Ansong,E.,Boateng,R.,Boateng,S.L.,&Anderson,A.B.(2017).The nature of e learning adoption by stakeholders of a university in Africa. E-Learning and Digital Media, 14(4), 226–243. doi:10.1177/2042753017731235

[7] Armstrong, E. A., Boadu, A. N., Nkrumah, N. E., Aweso, M. D., Nottinson, A. F., Samuel Baah–Duodu, S., Wotortsi, E., Afari, B. J., Amoh-Yeboah, R. & Dogli, C. P. (2020). "Coronavirus (COVID- 19) Pandemic and Online Learning Nexus in Colleges of Education in Ashanti-Brong Ahafo Regions (ASHBA), Ghana" International Journal of Research and Innovation in Social Science (IJRISS) vol.4 issue 5, pp.392-396 May 2020 URL: https://www.rsisinternational.org/journals/ijriss/Digital-Library/volume-4-issue-5/392-396.pdf

[8] Barzel, B. (2007). New technology? New ways of teaching - no time left for that! International Journal for Technology in Mathematics Education, 14(2), 77-90. 67

[9] Bayraktar, S. (2001). A meta analysis of the effectiveness of computer assisted instruction in science education. Journal of Research and Technology on Education, 34, 173-188.

[10] Bramald, R., Miller, J., & Higgins, S. (2000). ICT, Mathematics and effective teaching. Mathematics Education Review, 12, 1–13. 68

[11] British Education Communication Technology Agency (2004). Using web-based resources in secondary Mathematics. Retrieved January 10, 2009, from http://foi.becta.org.uk/display.cfm?cfid=1476190&cftoke

[12] Carter, M. B. (2004). An analysis and comparison of the effects of computer assisted instruction versus traditional lecture instruction students attitudes and achievement in a college remedial Mathematics course. Unpublished Doctoral Thesis, University of Temple. Philadelphia. USA.

[13] CBT Report (1999). Bill communications. Retrieved, June 2009 from http://www.ittrain.com/exec-sum.html 69

[14] Cekbas, Y. H., Yakar, B., Yildirim, A., & Savran, A. (2003). The effect of computer assisted instruction on students. Turkish Journal on Educational Technology, 2(4), 52- 59.

[15] Cepni, S., Ozsevgec, T., Saydkan, F., & Emre, F. B. (2004). The comparison of achievement levels of science teaching program students at two universities. V. International Science and Mathematics Education Congress Report. 2, 1241-1246.

[16] Cepni, S., Tas, E., & Kose S. (2006). The effects of computer assisted materials on students' cognitive levels, misconceptions and attitude toward science. Computers and Education, 46, 192-205.

[17] Cetin, U. (2007). A comparison of traditional teaching and the computer assisted education software based on ARCS motivation model in accordance with students' achievement and permanence of learning. Unpublished Master‟s Thesis, University of Gazi, Department of Computer Education and Instructional Technology., Ankara, Turkey.
[18] Clark, R. C., & Mayer, R. E. (2016). E-learning and the science of instruction: proven guidelines for consumers and designers of multimedia learning. John Wiley & Sons. doi:10.1002/9781119239086
[19] Cotton, K. (2001). Computer assisted instruction. Retrieved January 10, 2009, from http://www.nwrel.org/scpd/sirs/5/cu10.html
[20] Demirel, A., & Yagci, E. (2006). Principles and methods of Instruction. Journal of Applied Sciences, 8, 1067-1072.
[21] Demirel, A. (2004). Planning and evaluation in instruction: Art of teaching. Ankara: Pegem Publication.
[22] De Villiers, M. (2004). The role and function of experimentation in Mathematics and Mathematics education. Canadian Journal of Science, Mathematics and Technology Education, 4(3), 397-418.
[23] Fletcher, J. D. (1990). Effectiveness and cost of interactive videodisc instruction in defense training and education. Washington DC: Institute for Defense Analyses.
[24] Flynn, P. (1989). Introducing new technology into the workplace: The dynamics of technological and organizational change. New York: McGraw Hill
[25] Halis, I. (2002). Instructional technologies and material development. New York: Nobel Publication and Distribution.
[26] Hung, Y., & Hsu, Y. (2007). Examining teachers' CBT use in the classroom: A study in secondary schools in Taiwan. Journal of Educational Technology & Society, 10(3), 233-246.
[27] Jeffries, P. R. (2001). Computer versus lecture: A comparison of two methods of teaching oral medication administration in a nursing skills laboratory. Journal of Nursing Education, 40(7), 323-29.
[28] Vululleh,P.(2018).Determinantsofstudents'elearningacceptanceindevelopingcountries:An approach based on structural equation modeling. International Journal of Education and Development Using ICT,14 (1),141–151.