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Using Xerte Toolkit to Enhance Pre-Service Teachers' Conceptual Understanding of Coordinate Geometry

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ABSTRACT: This study was to investigate the effect and explore students' interest in using Xerte Toolkit in teaching and learning of Coordinate Geometry. In all, 50 pre-service teachers were involved in the study. The study adopted a mixed method approach. Semi – structured interviews as well as achievement test were the instruments used for data collection. The items in the achievement test were analyzed using statistical tools such as percentages, mean, standard deviation and t-test from Excel 2016 Analysis Tools. The descriptive statistics indicated that there was a significant difference between pretest and post test scores. The findings in this study posits that students' interest in using Xerte Toolkits in teaching and learning Coordinate Geometry has increased and are ever ready to use Xerte Toolkit again in their studies.

KEYWORDS: Conceptual Understanding, Pre – Service Teachers, Xerte Toolkit

INTRODUCTION

The study of geometry contributes to helping students develop the skills of visualisation, critical thinking, intuition, perspective, problem-solving, conjecturing, deductive reasoning, logical argument and proof (Clement, 2001). Geometric representations can be used to help students make sense of other areas of mathematics. The mathematics curriculum especially Geometry and Trigonometry of Colleges of Education provide student teachers with a background in the theory and application of the content needed to understand the underlying structure and nature of Geometry in Mathematics (UCC Course Manuel for Geometry and Trigonometry, 2018). In addition, it exposes student teachers to the content knowledge needed in preparing them sufficiently to learn Geometry beyond what they will be expected to teach at the basic education level. Mathematics curriculum in the Colleges of Education is therefore, intended to equip student teachers with the knowledge, skills and values needed to teach mathematics to basic school pupils in everyday life context. Besides, it provides the requisite resource material for preparing student teachers to teach mathematics sufficiently and effectively in our basic schools (Jones, 2002).

Presenting geometry in a way that stimulates curiosity and encourages exploration can enhance student's learning and their attitudes towards mathematics. By encouraging students to discuss problems in geometry, articulate their ideas and develop clearly structured arguments to support their intuitions can lead to enhanced communication skills and recognition of the importance of proof (Jones, 2002). According to the National Council of Teachers of Mathematics (NCTM, 2008), technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that their students have access to technological innovations such as Instructional televisions, computers and other multimedia technologies. Efficient teaching maximizes the potential of multimedia technology to develop students' understanding, stimulate their interest, and increase their proficiency in mathematics.

Literatures had shown that the advancement of computer has brought great innovation and thus school teachers need to be competent in using computers so that they would maximize its use in teaching and learning (Kumar, Rose, & D'Silva, 2008). In addition, the use of ICT has to be integrated in Mathematics Curriculum in both formal and informal ways and not just make it as an extra component. By integrating ICT into their everyday teaching practice, teachers can provide creative opportunities for supporting students' learning and fostering the acquisition of mathematical knowledge and skills (Hohenwarter & Hohenwarter, 2009).

It seems that the effects of Computer Assisted Instruction (CAI) in the teaching and learning of Mathematics is inconclusive with some studies indicating positive effects (Kulik, 2003), other studies showing no strong impact (Angrist & Lavy, 2002) and some studies finding negative effects (Spiezia, 2010; Campuzano, Dynarski, Agodini, & Rall, 2009) of using computer software. The mixed results may cause by the complexity of the relationship between ICT and learning. Other reasons are the wide variety of

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assumptions that have been made by research studies and the fact that the impact of educational technology has been studied from different perspectives (e.g., pedagogical, sociological, computer sciences and economics), in different teaching and learning environments and using different methodologies. All of this makes the findings of one study about the effectiveness of educational technology cannot be generalized beyond the teaching and learning context in which the study was performed.

Moreover, as remarked by some researchers (Slavin and Cheung, 2008; Cox and Marshall, 2007), a large majority of the past studies suffer from design flaws and methodological or conceptual weaknesses which raise doubt about the validity of their findings. Based on these findings that the researcher wants to test whether there will be positive or negative effects on the use of CAI (Maths Xerte toolkits) in teaching and learning Coordinate Geometry to enhance concept acquisition of Pre-service Teachers in a College of Education. The study sought to answer the following research questions:

1. To what extent will the use of Maths Xerte Toolkits as an instructional tool affect students' academic performance in Coordinate Geometry?
2. How will the use of Maths Xerte Toolkits improve the interest of students in the study of coordinate Geometry?

Impact of Computer Assisted Instruction

There had been abundance of research studies exploring a limited number of constructs in Computer Assisted Instruction (CAI) but there had been only modest attempts at building a theoretical base for CAI (Williams, 2000). There are several different views of what learning theory best fits learning by means of the computer. Williams advocated for the need for theoretical approaches to learning because of the differences we have in the learning theories. The behaviorist wants the learner to produce desired behaviors by controlling the environment while the constructivist wants to see how learning occurs. Williams found that an integration of behaviorist principles and constructivist principles may be best suited for computer-assisted instruction. Williams also concluded that there are those who believe that the theories and principles that guide practice in traditional face-to-face instruction cannot be directly converted to computer-based instruction. Others also concluded that a single learning theory is not enough, but that a quality learning environment should be based on instructional principles that are derived from multiple learning theories (Johnson and Aragon, 2002). However, there must be attempts at theoretical explanations for learning professionals to make teaching and learning decisions with confidence using this technology.

When Johnson and Aragon (2002) begun developing a framework for instructional strategies for use in the computer learning environment, they found a lack of evidence that technology significantly influences the learning process. Johnson and Aragon hypothesized that quality learning environments should be based on instructional principles that are derived from multiple learning theories. The challenge is to devise ways to create pedagogically sound content for delivery by the computer. The information to be learned needs to address variability in learning styles, provide motivation, and promote interactivity. Johnson and Aragon suggest that the learning environment should be comprised of the elements in behavioral, cognitive, and social learning theory.

According to Cheung and Slavin (2013), over 20 major reviews of education technology have been conducted over the past 30 years and the majority of these studies have concluded that technology applications show positive effects on student achievement of which Geometry is part. Cavanagh and Mitchelmore (2011) explained that educational technology used for low-level tasks such as drill and practice have shown no significant effect on student learning outcomes. This is attributed to the formats closely resembling printed versions of similar rote learning exercises. The findings of Cavanagh and Mitchelmore contrast a meta-analysis of 254 controlled evaluation studies by Kulik and Kulik (1991) which cover students ranging from kindergarteners to adults and show computer-based instruction usually produces positive effects for students. Lei and Zhao (2007) have shown that both the quantity and quality of technology usage impact student achievement. In a study of 130 middle school students in Ohio, Lei and Zhao found that students who used technology at school for more than three hours per day experienced a decrease in achievement. Conversely, students who utilized technology for one to three hours per day demonstrated an increase in academic achievement. Lei and Zhao suggested that the quality of the technology needed to be ensured before the quantity of time on computers increased, otherwise the increased computer time could cause more harm than benefit. In regards to quality of technology use, students who were involved in higher level tasks such as webpage development and programming had increased achievement compared to students using technology for basic tasks such as taking notes with a word processing program. However, the researchers did not report any interaction effects of quantity and quality on student achievement.

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A meta-analysis (Cheung, 2013) of 154 studies involving approximately 120,000 K-12 students revealed several important classroom technology usage factors. Programs that required students to use computers 30 minutes or more per week had a larger effect on student achievement than ones that required less. The implementation level was also a contributing factor to student achievement. The average effect size of programs with higher levels of implementation was significant but very small when compared to programs with lower levels of implementation. While Cheung reported these findings as significant, the effect sizes are so small that little effect can be attributed to the level of implementation. Cheung's analysis also suggests that education technology has a more positive effect on secondary students than on elementary students.

Despite the wide range of adaptive system types and modern advances in CAI, no current systems have synchronous capabilities to link students to each other or create communities of learners. Social interaction is a crucial element in the measurement of both cognition and engagement and should be considered an essential element of an adaptive course. Personalized learning should be seen as a piece of a larger educational picture where students collaborate in teams and share resources (Pugliese, 2016).

Although, there are some research studies which indicate little or no effect in the use of Computer Assisted Instruction. However, a greater number of them yielded positive effects. These positive effects can be attributed to how well the CAI interact with students, the preparedness of students to learn on their own using Computers, the availability of quality hardware and software, access to quality internet connectivity if is online, theories underlying the instructions, number of hours a student spent on the computer, teacher support for students and others. These positive attributes will enable the researcher to use all possible means to help students make good use of the Maths Xerte toolkits in Coordinate Geometry to improve upon their performance.

With the integration of multimedia elements such as texts, images, animations, and videos in the Maths Xerte toolkits, will offer unprecedented opportunities to students to learn Coordinate Geometry with less difficulties or no difficulties. It will also help students to interact, create, use and experience the various tools in the Maths Xerte to sketch the behaviour of graph and other computations in Coordinate Geometry. These will boost students' confidents and give them better understanding since students can use all their senses in the learning process and also can cater for different learning styles. In addition, the Maths Xerte toolkits will increase student interest, reduce anxiety, provide more time on task, and provides instant feedback for the student, self-sufficient learning, independent learning, and the ability to represent content in a variety of media.

RESEARCH METHODS

In this study the sequential explanatory design was used as the researcher intended to establish the effects of Xerte Toolkits in teaching and learning of Coordinate Geometry by comparing between the students' score before being taught by using Xerte Toolkits and after being taught by using Xerte Toolkits through the use of both quantitative and qualitative methods. Venkatesh et al. (2013) points out that in a sequential mixed methods design, quantitative and qualitative data collection and analysis are implemented in different phases and each is integrated in a separate phase. When the data are introduced in phases, either the qualitative or the quantitative approach may be gathered first, but the sequence relates to the objectives being sought by the researcher (Molina & Cameron, 2010). Fifty (50) pre-service teachers participated in the study. Questionnaire and interview were the instrument used for data collection.

RESULT AND DISCUSSIONS

1) Effects of using computers as an instructional tool in the teaching and learning process of Coordinate geometry

The major research question raised for the study was to examine how the use of Computer Assisted Instruction applications such as Xerte toolkits could improve upon pre-service teachers' concept acquisition in questions involving coordinate geometry at the College of Education. In order to accomplish this, pre-service teachers were given pre and posttest on coordinate geometry.

Pre – service teachers were first given a pre-test and then exposed to a series of instructional teaching after which they were given a post-test. The post-test was administered after students were introduced to the treatment with regard to the use of the Xerte toolkits. The post-test questions were similar to the pre-test questions and this assisted the researcher to assess the effectiveness of the treatment employed and also the student's mastery over the concept coordinate geometry. Pre-service teachers were marked out of twenty (20). The bar chart depicts pre-service teachers pre and posttest scores in coordinate geometry.

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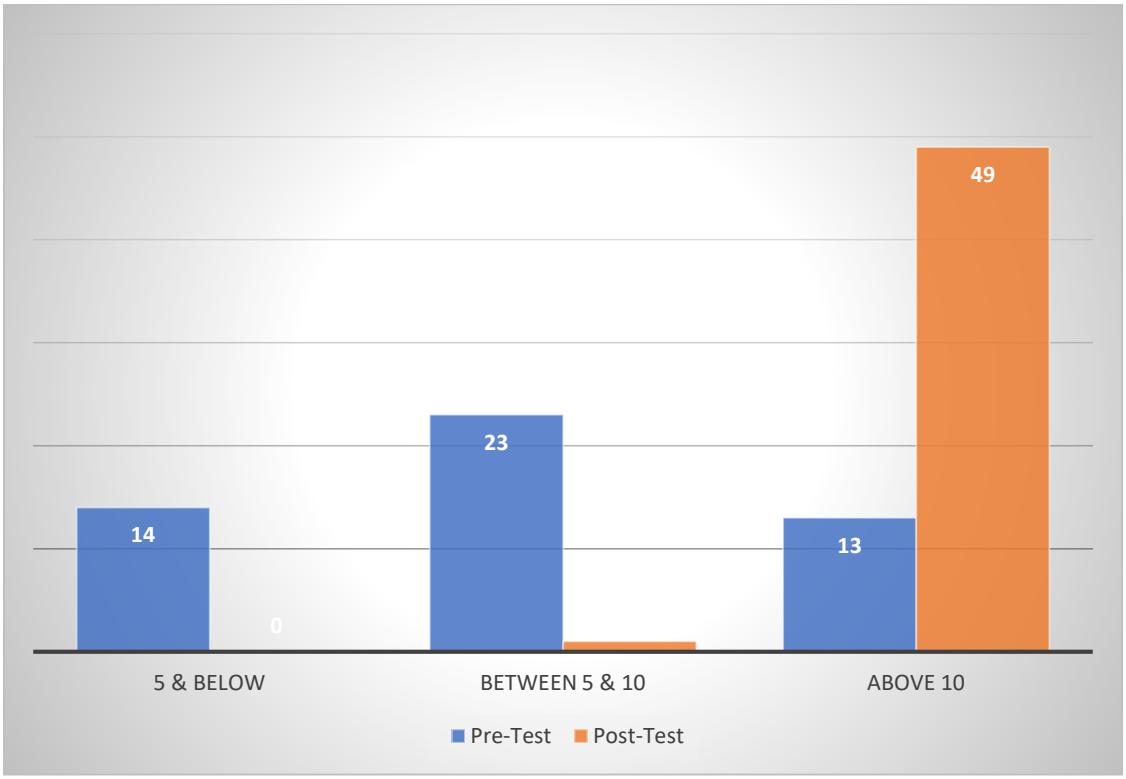

Figure 1. Bar Chart of Pre – test and Post – Test score

From Figure 1, unlike the pre – test where 14 pre – service teachers had a mark of 5 and below, no pre – service teacher had a mark below 5 in the post – test. Whereas 23 pre – service teachers had a mark below the average pass mark of 10 in the pre – test, the post – test recorded just a mark within this range. Also, more than 90% of the pre – service teachers had a pass mark in the post test. Table 1 shows the descriptive statistics of pretest and post test results of students on coordinate geometry.

Table 1: Descriptive statistics on pre-service teachers' pre-test and post-test scores

	N	Mean	Std. Deviation	Minimum	Maximum
Pre – Service Teachers pre test	50	7.4	2.7	2	13
Pre – Service Teachers post test	50	14.6	3.4	9	20

Table 1 indicates that there was a difference in pre-test and post-test scores with respect to the minimum, maximum, mean and standard deviation with the post test score being better than pretest scores. (i.e. with pre-test mean and SD 7.4 and 2.7 and post-test mean and SD 14.6 and 3.4).

Further analysis was conducted to find out whether the difference in means was statistically significant. A paired-sample t-test was used to test the null hypothesis that there is no effect on using computers as instructional Tools in teaching and learning of Coordinate Geometry in the College of Education. The t-test was used because the researcher had only one group of people and collected data from them under two different conditions or occasions. Table 2 shows the paired sample statistic of pre – test and post – test scores.

Table 2: Paired Sample t test for Pre – test and Post – test scores

	N	**Mean**	**Std. Deviation**	**df**	**T**	**Sig(2 - tailed)**
Pre – Test	50	7.4	2.7			
Post – Test	50	14.6	3.4	49	-11.2250	0.0000

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The statistical test was set at $\alpha = 0.05$. The results of the t-test (49df, t= -11.2250, and p=0.00) indicates that the difference in means was significant at p=0.00. Since P is less than 0.05, level of significant; the null hypothesis that there is no effect on using computers as instructional Tools in teaching and learning of Coordinate Geometry in the College of Education is rejected in favor of the alternative hypothesis. It can be argued that there was statistically significant difference between the post-test and pre-test in favour of the post test.

This result is in line with Cheung and Slavin (2013) study. They conducted over 20 major reviews of education technology over the past 30 years and the majority of these studies have concluded that technology applications show positive effects on student achievement of which Geometry is part. However, Cavanagh and Mitchelmore (2011) explained that educational technology used for low-level tasks such as drill and practice have shown no significant effect on student learning outcomes. This is attributed to the formats closely resembling printed versions of similar rote learning exercises.

The findings of Cavanagh and Mitchelmore contrast a meta-analysis of 254 controlled evaluation studies by Kulik and Kulik (1991) which cover students ranging from kindergarteners to adults and show computer-based instruction usually produces positive effects for students. Lei and Zhao (2007) have shown that both the quantity and quality of technology usage impact student achievement. In a study of 130 middle school students in Ohio, Lei and Zhao found that students who used technology at school for more than three hours per day experienced a decrease in achievement. Conversely, students who utilized technology for one to three hours per day demonstrated an increase in academic achievement.

2) **Pre – Service Teachers Interest in using Maths Xerte Toolkits in teaching and learning Coordinate Geometry**.

The researcher conducted interview for fifteen (15) pre – service teachers to elicit their response on the technology in terms of their interest. The responses from the interview posits that interest in understanding of coordinate geometry concept have aroused after using the Xerte toolkits. For instance, student A was of the view that :

"I can now work independently and Xerte toolkits has increased my interest and motivational level in learning coordinate geometry".

Student C also added

"*my confidence level has improved and I can now solve coordinate geometry questions with little or no help*".

This shows that Xerte toolkits has actually stimulated their conceptual understanding of coordinate geometry. Also all the interviewee responded that their competence level has improved and Xerte toolkits interface is user friendly therefore they intend to use the tool again in their studies. This is in conformity with the findings of Chen (2017) which indicated that computer-aided instruction has proven to be effective on the improvement of students' academic achievement, practicable teaching method and students learning interests and attitude. It also supports Chalmers et al. (2018) assertion that CAI is a tool use to support interactivities in the teaching and learning process which intend help learners learn concepts with ease.

CONCLUSION

Based on the findings of the study, Xerte toolkits has effectively enhanced pre-service teachers' performance in coordinate geometry. Hence, recommend the use of Xerte toolkits in order to improve pre-service teachers' understanding of mathematics concepts. Similar studies may be conducted to a wider scope using different population to promote the generalizability of the results.

RECOMMENDATION

The following recommendations were made based on the findings and the conclusions of the study:

i. Looking at the positive impact of the study, the government should support the integration of ICT in teaching and learning of mathematics by supplying ICT facilities such as internet, computers, and software and among others to Colleges of Education.
ii. To be abreast with xerte software in teaching and learning mathematics, management of Colleges of Education should organize workshop and training for mathematics tutors periodically.
iii. Management of Colleges of Education should encourage the use of computers and xerte software in teaching and learning of mathematics.

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iv. To support interactivities in teaching and learning process, students must be encouraged to use the Xerte software on their phones and other computing devices in the college so as to arouse their interest in acquiring mathematical concepts.
v. Mathematics teacher should acquire knowledge of variety method of teaching to enable them vary their teaching method.
vi. Mathematics tutors in the College should use part of their instructional period and give a brief tutorial on how to use Xerte Software in order for students to increase their interest and enhance their academic achievements.

REFERENCES

1. Angrist, J., & Lavy, V. (2002). New Evidence on Classroom Computers and Pupil Learning. *The Economic Journal, 112* (482), 735-765.
2. Campuzano, L., Dynarski, M., Agodini, R., & Rall, K., (2009), Effectiveness of reading and mathematics software products: Findings from two student cohorts. Institute of Education Sciences, *National Center for Education Evaluation and Regional Assistance.*
3. Cavanagh, Michael & Mitchelmore, Michael. (2011). Learning to teach secondary mathematics using an online learning system. *Mathematics Education Research Journal. 23. 417-435. 10.1007/s13394-011-0024-1*.
4. Cheung, A. (2013). Effects of educational technology applications on student achievement for disadvantaged students: What forty years of research tells us. *Cypriot Journal of Educational Sciences*, *8*(1), 19-33.
5. Cheung, A., & Slavin, R. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review*, *9*, 88-113.
6. Clements. D. (2001), Teaching and Learning Geometry. In J. Kilparick (Ed), *Research Companion to the NCTM Standards for Mathematics.* Reston, VA: NCTM.
7. Cox, M.J., & Marshall, G. (2007). Effects of ICT: Do we know what we should know? *Education and Information Technologies*, *12*(2), 59-70.
8. Hohenwarter, J., & Hohenwarter, M. (Writer) (2009). Introducing Dynamic Mathematics Software to Secondary School Teachers: The Case of GeoGebra [Article], *Journal of Computers in Mathematics & Science Teaching*: Association for the Advancement of Computing in Education.
9. Johnson, S. D., & Aragon, S. R. (2002). An instructional strategy framework for online learning environments. In T. M Egan & S. A. Lynham (Eds.), *Proceedings of the Academy of Human Resource Development Annual Conference (41-1). Bowling Green, OH: Academy of Human Resource Development.*
10. Jones, K. (2002), Issues in the Teaching and Learning of Geometry. *In*: Linda Haggarty (Ed), *Aspects of Teaching Secondary Mathematics: perspectives on practice*. London: Routledge Falmer. Chapter 8, pp 121-139. ISBN: 0-415-26641-6
11. Kulik, C. & Kulik, J. (1991). Effectiveness of computer-based instruction: An updated analysis. *Computers in Human Behavior. 7. 75-94. 10.1016/0747-5632(91)90030-5.*
12. Kulik, J. A. (2003). Effects of using instructional technology in elementary and secondary schools: *What controlled evaluation studies say. SRI International Report*.
13. Kumar, N., Rose, R. C., & D'Silva, J. L. (2008). Teachers' Readiness to Use Technology in the Classroom: An Empirical Study. *European Journal of Scientific Research, 21*(4), 603-616.
14. Lei, J., & Zhao, Y. (2007). Technology uses and student achievement: A longitudinal study. *Computers & Education, 49*(2), 284-296.
15. Molina, A., & Cameron, R. (2010). The Application of Mixed Methods in Organisational Research: A Literature Review. *The Electronic Journal of Business Research Methods vol. 8*(2), 95-105.
16. *NCTM* (2008). *The role of technology in the teaching and learning of mathematics: A position of the National Council of Teachers of Mathematics.* Retrieved from http://www.nctm.org.com
17. Pugliese, L. (2016). Adaptive learning systems: Surviving the storm**.** *Educause Review.* http://er.educause.edu/articles/2016/10/adaptive-learning-systems-surviving-thestorm.
18. Slavin, R.E., Chueng, A., Groff, C., & Lake C. (2008). Effective reading programs for middle and high schools: A best-evidence synthesis. *Reading Research Quarterly, 43(3), 290-322.*

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www.ijcsrr.org

19. Spiezia, V. (2010). Does computer use increase educational achievements? Student-level evidence from PISA. *OECD Journal: Economic Studies, Volume 2010*.
20. Stefan, D. (2013). Questionnaires. Retrieved from Research & Consultation Guidelines: http://www.kirklees.gov.uk/ community/yoursay/ questionnaires.pdf study. *Computers & Education, 49(2), 284-296.*
21. UCC (2018). *Course Manuel for Geometry and Trigonometry for College of Education*, University of Cape Coast, Cape Coast.
22. Venkatesh, V., Brown, S., & Bala, H. (2013). Bridging the Qualitative-Quantitative Divide: *Guidelines for Conducting Mixed Methods. Research in Information Systems. MIS Quarterly Vol,37*(1), 21- 54.
23. Williams, S. W. (2000). Towards a Framework for Teaching and Learning in an Online Environment: A review of the literature. In K. P. Kuchinke (Ed.), *Proceedings of the Academy of Human Resource Development Annual Conference (1-2).* Baton Rouge: Academy of Human Resource Development.

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