Impact of Instructional Object Based Card Game on Learning Mathematics: Instructional Design Nettle

Olatoye Mukaila Ayinde

University of Botswana

Gaborone.

P.M.B 009

Department of Educational Technology

mukailaolatoye@yahoo.co.uk

Abstract

This paper describes the design process of an Instructional Object Based Game (IOBG) which was designed using Technological Pedagogical and Content Knowledge (TPACK) principles and assesses its impact on the performance of students learning in mathematics as investigated from two sets of subjects. The unit of analysis consists of two hundred (200) Junior Secondary School 2 (JSS 2) students selected from 20 co- educational schools within Lagos Island and Eti-Osa educational Zones of Lagos State, Nigeria. Multi stage stratified random sampling was used to avoid interclass mixed situation. A fifty percent (50%) proportionate on each zone and stratified simple random sampling technique was adopted to give non mixed schools within the zones equal chance of being taken. A quasi-experimental control group design with repeated measures analysis of covariance was adopted. Two separate summary results of ANCOVA showed that F (1,199) = 12.88 @ p = 0.013 and F (1,193) = 13.00 at p = 0.00 implied that the use of OBG (game) in teaching and learning had significant effect on the performance of learners in Mathematics. The calculated mean scores and 2-way ANCOVA results also showed that gender has no significant influence on the performance of learners in either the used of IOBG or MAT.

Keywords

Instructional game, Animated Object Card Based Game, Technological Pedagogical and Content Knowledge (TPACK), Conventional method.

Introduction

Enhancing teaching and learning outcomes through relevant instructional strategies has been a major concern in educational block. Many researchers identify inherent unfairness in school based teaching techniques, lack of adequate instructional materials, truancy and assessment (Grifith 2005 and Asim 2007) which may result from teachers' incompetency in assessment and learning delivery

(Asim et al. 2009). These problems have been blamed in part, on the methods of imparting knowledge to learners. The general consensus is that, the mode of instruction has become grossly inadequate to handle the needs of learners. The present delivery system is considered obsolete, inefficient and incapable of achieving pedagogical objectives. (Chandra and Lioyd 2008).

In essence, inadequacy of instructional materials and lack of effective teaching strategies assumed to have resulted into the decline in the standard of education and its detrimental effects on the social-economic and technological development of most developing countries in Africa. This has been a major challenge in educational thinking and policy formulations in recent times. Some scholars blame the colonizers of Africa for applying direct transfer of Western curricula, examinations and teaching methods, which fail to address the continental challenges of Africa (Asim et al. 2009). Yoloye (2008) submitted that the result of this direct transfer of western curricula, in science and mathematics decontextualized pedagogical objectives and the knowledge being transmitted by poorly trained teachers. As a Consequence, the situation in Nigeria is that, academic performance in post primary education is still deplorably low particularly in mathematics, both in certificate and non certificate examinations (Asimeng-Boahene, 2010).

The scrutiny of how well students are learning depends heavily on the assessment of teaching effectiveness. Teaching effectiveness in this context is defined as the act or skill in the organization of pedagogy, content and knowledge of subject matter that does not devoid adequate instructional technology. Shulman (1986) asserts teaching as pedagogy that involves knowing of how to take advantage of different teaching approaches that make a learning experience most suitable for the learners. This includes being flexible and adjusting instruction to account for various learning styles, abilities and interests of learners. The variances of pedagogical and technological approaches become a necessity to address the present day abstract and drill teaching “chalk and talk” that dominated both private and public schools.

There is need however, to incorporate self-motivated experience scenes such as gaming, which characterized play and activity as being the young child’s most powerful tool in all areas of learning particularly mathematics. The gaming activities used in this study integrated content-specific technologies and appropriate pedagogies (e.g., problem-based learning), grounded in Technological, Pedagogical and Content Knowledge (TPACK) framework.

Instructional Games

Instructional Games can be viewed as a process of chance, its competitive interactions bounded or guided by rules to achieve specified (instructional and behavioral) goals that depend on skill, dexterity ingenuity of the player chance and imaginary prose in a content of school subject.

Games are inept to cultural instinct that symbolizes ethics, cultural value of indigenous setting, which varies from beliefs, cultures, norms, values, tradition and need. Cultural games such as AYO, OKOTO (cone shape game), OFA change with taste of time. AYO (16 seeds) game that was adopted by the Yorubas (one of the major tribes in Nigeria) serves as a spring board for counting and intuition to basic IFA Orthodox (Olatoye, 2002).

Play, during early childhood, positively influences important psychological, sociological and intellectual development. (Rieber,1996). Today play is closely associated with video and computer games. Of the many types of games available it appears that educational researchers have concentrated on simulation and adventure games. Which were not taken into cognizance the three domains of individual learner (Amory, Naicker, Vincent, and Adams 1999).

Types of Instructional games

Game in this context can be classified into two i.e educational and instructional games. Educational games are any other games that are used for entertainment and educational purposes. While instructional games are games design using subject content derive from curriculum specifically structured to suit a topic or more in content area.

Elements of Instructional Games

- Players: the decision makers in the game.
- Actions: choices available to a player
- Information: knowledge that a player has when making a decision.
- Strategies: rules that tell a player which action to take at each point of the game.
- Outcomes: the results that unfold.

The objectives identified for this study are as follows:

1. To design, and develop Instructional Object Based Game (IOBG) using TPACK principles to be used to assess the effectiveness of an innovative teaching approach (gaming) compared to traditional teaching methods.
2. To assess OBG effects on the performance of students' in JSS 2 Mathematics against the traditional teaching methods.
3. To investigate whether gender contributes to the performance of students in Mathematics.

Purpose of the Study

The main purposes of this study was to firstly, design IOBG using TPACK principles and secondly to investigate the impact of IOBG on students learning of a selected topic in Mathematics in the JSS2 classroom using some quasi experimental design. The study will also to assess if there exist any gender differences among the group treated with the card game. The study has therefore identified the following research questions:

Research Questions

1. To what extent do the mean scores of students treated with card game techniques vary from students using traditional method of learning substitution?
2. What is the effect of gender composition of students treated with OBG (card game) and those treated with traditional method of learning substitution?

Relevant Literature

For decades, studies have shown that gaming has been used to support students' learning and improve academic performance of students' (Gee, 2009). Reflecting the interests of the educators, studies have been conducted to explore the effects of games on students' achievement. Oblinger (2010) showed that computer games have received a lot of attention from educators as a potential way to provide learners with effective and fun learning environments. Gee (2009) agreed that a game would turn out to be good for learning when the game is built to incorporate learning principles. Some researchers have also supported the potential of games for affective domains of learning and fostering a positive attitude towards learning (Ke 2008; and Vogel et al. 2006).

Rosas et al. (2008) found a positive effect of educational games on the motivation of students. Although there is overall support for the idea that games have a positive effect on affective aspects of learning, there have been mixed research results regarding the role of games in promoting cognitive gains and academic performance. In the meta-analysis, conducted by Vogel et al. (2006), thirty two (32) empirical studies were examined and concluded that the inclusion of games for students learning resulted in significantly higher cognitive gains compared with traditional teaching methods. Similarly, Annetta, Mangrum, Holmes, Collazo, and Cheng (2009) tested the effects of educational games by incorporating them into a 5th grade science class and found significantly positive results in the students' performance. Similar positive effects were observed in math performance by Ke and Grabowski (2007).

In a separate study Ke (2008) tested the effect of educational games compared with traditional paper-and-pencil drills. He did not find a significant effect of games on the math performance of four hundred and eighty seven (487) 5th-graders. The specific interest of this study is to design an Instructional Object Based Game (IOBG), keeping within the current trajectories of TPACK research. Doering and Veletsianos (2007) identified game technological pedagogical content knowledge as a necessary component for teacher education programs to focus on so as to facilitate and increased integration of game technologies (GT) into Junior and secondary school classrooms.

TPACK and Mathematics

Essentially, TPACK consists of the negotiation of synergy between three forms of knowledge; these are Technological Knowledge (TK), Pedagogical Knowledge (PK) and Content Knowledge (KC). Cox (2008) define TPACK as:

> …knowledge of the dynamic, transactional negotiation among technology, pedagogy, and content and how that negotiation impacts student learning in a classroom context.

The essential features of TPACK are: (a) the use of appropriate technology (b) in a particular content area (c) as part of a pedagogical strategy (d) within a given educational context (e) to develop students' knowledge of a particular topic or meet an educational objective or student need. Because of the role of content knowledge in teaching there is need to incorporate TPACK in various content areas in mathematics.

Martorella (2005) referred to technology in Mathematics education as "the sleeping giant" whose potential had not yet been realized. Today, mathematics teaching and learning is still dominated by traditional pedagogical practices that are primarily teacher centered, with technology, for the most part, still not being used in transformative ways, if at all (Cuban, 2008; Doering, Veletsianos, and Scharber, 2007; Lee, 2008). Indeed, research on technology integration in mathematics and its "tasks" in classrooms continues to be minimal. (Berson and Bayata; 2010; Doering, Veletsianos, and Scharber 2009; Friendman and Hicks 2010; Ross, 2010; Swan and Hofer 2008).

Doyle (2010) elaborates that "tasks influence learners by directing their attention to particular aspects of content and by specifying ways of processing information. Different tasks provide different opportunities for learning with "the setting of a task opening up the potential for learning" (Watson and Sullivan 2008 p. 112). High level cognitive tasks support deeper mathematical thinking as posited by Singh, Granville, and Dika (2002). The term mathematics task in this study refers to an activity that is purposefully designed or selected to develop card game structured with TPACK principles and mathematics content knowledge for teaching and learning the concept of substitution. This study has integrated the use of TPACK approach through the use of gaming in teaching mathematics.

Learners' Performance

Although there has been much reform in the way math is taught, many math curricula are still structured for the purpose of teaching students a plethora of isolated math concepts, often incorporating a "drill and kill" method of teaching. This does not encourage students to develop a strong conceptual foundation, making it very difficult for them to make relevant connections. It also does not teach students how to solve problem, reason mathematically and this may cause poor performance in mathematics (Johnson and Johnson 2011; Corbeil 1999; Eke ,1986).

Reflecting on the interests of the educators, studies have been conducted to explore the effects of games on students' performance. However, there has been no consensus on the effects of computer games and object based games. Some studies support computer games as educational resources while other see instructional object based games structured with pedagogical content as instructional resources to promote students' learning (Annetta et al. 2009; Vogel et al. 2006). Certain societal stereotypes can also inhibit a student's performance in mathematics. The idea that men are better at math than women, mathematics ability is inherited (Fillier 2009). This study also sought to establish empirical evidence to support or deny this body of knowledge.

Gender

Of all learners' characteristics in relation to computer games and object based games, researchers have been interested in gender differences. Gender differences have been noticed in a number of studies ability. According to Haertel et al. (1981), no gender differences are apparent in the early years, but by high school age (approximately 14), males do better at arithmetical reasoning. Also males consistently outperform females on tests of spatial ability; this difference persists from the early grades through high school. It was discovered that men's average scores on the mathematical scale on Scholastic Aptitude Test (SAT) scores were above women's average scores. Kinzie and Joseph (2008) conducted a survey on forty four (44) students and presented a list of gender differences related to instructional games among middle school aged students: more boys (more than 80 %) played the computer game compared with girls (less than 30 %); girls prefer creative and explorative play, while boys prefer active and strategic play.

In a similar vein, Hartmann and Klimmt (2010), based on two survey results conducted respectively on three hundred and seventeen (317) and seven hundred and ninety five (795) individuals of an average age of twenty one (21) found gender specific preferences for game features. They showed that females enjoyed games featuring meaningful social interactions but were less attracted to competitive aspects of games compared with male.

Is there a gender difference in cognitive gain when students play games in school?

Vogel et al. (2006) through the meta-analysis of various studies on gender showed that there was no significant performance difference between the two genders and concluded that both genders benefited from instructional games cognitively. Also, Annentta et al. (2009) found no significant gender difference in Science achievement in examining the effect of instructional games on the science achievement of fifth (5^{th}) graders. The literature shows that gender plays a role in technology integration and also that there are significant differences between males and females in terms of the ability to use technology (Agosto 2009; Hartmann and Klimmt 2010). The researcher believes that the situation could have changed now given that women have the advantage to train for any type of job that they like as there are currently less gender restrictions in terms of technology use in schools.

Enhancing TPACK principles with IOBG

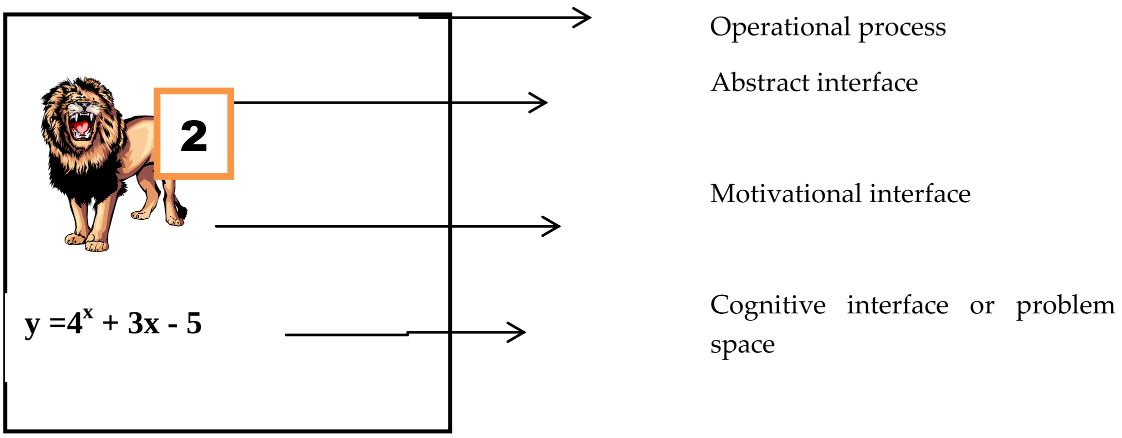
Instructional Object Based Game Model (IOBGM) was originally presented by Amory (2001) to describe a relationship between the pedagogical processes of learning and game elements and is loosely based on the object oriented computer programming system paradigm. The essence of adopting IOBG was to support the development and designs of instructional games that take care of both Pedagogical Content Knowledge (PCK) and TPACK principles in the production of games in which the learners could touch, feel, and facilitate all domains of learning.

Amory et.al (1999) consider object based educational games to consist of a number of components (objects), each of which is described through abstract and concrete interface. Abstract interfaces refer to pedagogical and theoretical constructs. While concrete interfaces refer to design elements that serve as two main principles, those of TPACK that were used in creating the substitution card games (SCG) for this study.

SCG (Card games) space object includes visualization space and problem space objects. These spaces consist of motivational interface, challenges and engagement that relate to cognitive activities. These include critical thinking, self discovery, goal formation, and goal completion. The problem space includes manipulation memory, logic and Mathematics. The teacher is therefore required to know various categories of instructional games to ascertain what is available for use and what is applicable or suitable for various skills or concepts.

Substitution Card Game using TPACK principles.

Figure 1: Substitution Card Game using TPACK principles sample.



The game cards were designed in line with TPACK principles as identified in Figure 1 that: the card game spaces object include: the visualization space and problem objects. These spaces consist of motivational interface, (from Figure 1 the animal represents this interface) challenges and engagement that relate to cognitive activities (such as critical thinking, self discovery, and goal completion). Cognitive interface or problem space is represented by $Y= 4^x + 3x – 5$ on Figure 1.

Abstract interfaces refer to all pedagogical and theoretical constructs from Figure 1; 2 (two) that appears on the animal as identified on the abstract interface of the sample card. The card contents area or cognitive levels were structured by using Bloom (1959), taxonomy of knowledge as specified in the Table 1 Table of specification,

Connection of symbols and representations of equations

Manipulation of substitution encourages the player to connect symbols and representations of equations. Playing with linear equations makes the player familiar with the substitution process. Furthermore, the player is making sense of number and symbols on visible linear equation before the value of card is obtained. When fraction like equation appears for example, **Y =3X/2** the player gains the ability to construct representation of fraction and combination of two to three operations.

Method

Research shows that to learn mathematics students must, with quality instruction, master basic mathematics skills (such as arithmetic operations) in the early stages of the learning experience (Miller & Robertson, 2010). Condie and Munro (2007) showed that game may be an optimal teaching and learning approach to facilitate student learning of basic mathematics skills such as simple algebraic substitution and inverse operations. The study used MAT and design card game structured with TPACK framework to teach substitution against the conventional method of teaching.40 minute's lesson on substitution was conducted for the two groups for two weeks, twice per week. The lessons were conducted in each school for 4 weeks in the whole of the two zones.

After the lessons, groups were treated with MAT and IOBG, control and experimental groups respectively

Research Design

The study is a quasi-experimental pretest-post test control group design.

Subjects

The sample consists of 200 JSS 2 students selected from 20 co- educational schools within Lagos Island and Eti-Osa educational Zones of Lagos State, Nigeria. Multi stage stratified random sampling was used to avoid interclass mixed. 50% proportionate on each zone and stratified simple random sampling technique was adopted to give non mixed schools within the zones equal chance of being taken. 100 subjects were assigned to each group; experimental (A) (card game) and control group B (traditional method). The first sets of subjects were learning in relation to game and performance, while the other set (control group) was treated with Mathematics Achievement Test (MAT) (conventional method). Lessons of 40 minutes on substitution were conducted for the two groups for two weeks, twice per week, which was conducted in each school for 4 weeks in the whole of the two zones. After the lessons the groups were treated with MAT and IOBG, control and experimental groups respectively.

Instruments

Table 1 specified the contents and blooms taxonomy of cognitive test .Mathematics Achievement Test (MAT) as specified in Table 1 was designed in paper and pencil test after been taught the contents. This was administered to control group. While OBG were design in form of cards as specified in Figure 1. The cards were constructed and used for experimental group in the study. The cards consisted of 30 pieces of cards each has as specified in Table 1. The MAT was also 30 item achievement test designed based on substitution administered to group B (control group) as pencil and paper test. The reliability of MAT was established using Kudernts Richardson formula 21 found to be .86. Instructional Objects Based Game (IOBG) was constructed with the reliability using Cronbach’s alpha to be .89 the two instruments have the same contents and pedagogical processes.

Table 1 Test Items for MAT and OBG

Contents	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
Simple equation	Q1, y=8*x if x is 8	Q13 & Q21 X=3, if 5 is divided by x to give k, 2 is divided by k to give y. what is y? Q21 if x is 8 what is y? in y=x - 6	Q2 & Q20 Q2 x is 8, when x^2 is substrate from x to give y Q20. 10 is substituted for X in question 20 to get y, what is y? (20). y =5X – 3	Q26. y=X + 5. If X is 8, what is y	Q18. 10 is substituted for X in this equation to get y $y = X + X^0$	Q24. Evaluate y in the equation, given that x is equal to 8 y =4 x X
Linear substitution	Q7.y = X x 4, if X = 10 what is y?	Q14.If X is 15 and is added to 10 to give the value of y. what is y? Q23.If X is 8, what is y in y= 3X + 2	Q10.If X = 7, what is y in this equation? $Y = 3X – X^0$	(27).y=3X If X is 8, what is y in the equation?	Q29. If X is 8, what is y $y=X^2 +2$	Q11.What is y? if X is 12 and multiplied by X^0 to give y
Inverse operation	Q9. What is y? if X is 13 in this equation, given that y =(X-3)/2 Q25. X=8, what is y? 25y= X/2	Q30. If X is 8, what is y in the following equations ? $y=2X^2$	Q19.10 is substituted for X in question 19 to get y, what is y? $y = 2X +X^0$ Q22. If X is 8, When X^2 is substrates from X the result is y, what is y ?	Q12.X = 7 calculate y in this equation y = -21/X.	Q6. X=7, substitute for X to get y in this equation y/8 = X-2	Q4. Evaluate y, if X=9 in this equation $y= 2X^2$
Quadratic substitution	Q5. X is equal to 11, X is substrates for X^2 and 3 is added, the result is y what is y? Q17. X is 15 and 5 is subtracted from X^2+X and I got y. what is y?	Q15 x is 4, what is y? in $y=2x^2 – 3x -2$	Q16. X is 4, what is y in $y = 2X^2 – 3X - 2$?	Q3. What is y? if X = 3, $y=5X^2-2X+2$	Q8. If X=15, what is y? in this equation, $y= X^2-2X+2$	Q28. Evaluate y if x = 8 $y=X^2 – 2X + 2$

Sampling Procedure

Ten subjects were chosen from each school with the same number of male and female to give the total of 200 subjects from 20 schools chosen from the two educational zones using purposeful stratified random sampling. The subjects were divided into two groups i.e. experimental and control groups. The experimental and control groups were treated with OBG and MAT respectively. Before the treatment, the subjects were given test (pre-test) related to substitution. 40 minutes Lesson on substitution was conducted for the two groups for two weeks, twice per week. This was conducted in each school for 4 weeks in the whole of the two zones. After the lessons the groups were treated with MAT and OBG, control and experimental groups respectively.

Results

Mean, standard deviation and analysis of ANCOVA (was used as a result of covariate existed due to the treatment assigned to experimental group) were used to provide answers to research questions and test the significant difference that may exist between variables.

The first research question one sought to investigate if there was: any difference between the performance of students treated with IOBG (card game) technique in selected topic in Mathematics compared with the students treated with traditional method of learning Mathematics. The results are shown below.

Table 2 presents the descriptive statistics (mean and standard deviation of the card game and traditional (conventional) methods). The descriptive analysis shows that the mean and standard deviation score for the treatment group are 3.86 and .999 respectively against 3.13 and .846 for the control group. This suggested that the experimental group performed better than the control group which has lesser mean and standard deviation scores.

Table 2. Descriptive statistics of the teaching methods (card game and traditional)

Card game method	Traditional method	
No of cases	100	100
Pre test mean	3.113	2.440
Post test mean	3.857	3.133
Mean gain	0 .744	0 .693
Post test standard deviation	0.9986	0 .8458

Table 3 contains F (1,199) = 12.88 at p = 0.013, this implies that the use of OBG (game) in teaching and assessing learning outcomes had significant effect on the performance of learners in mathematics. That is game (structured IOBG) has impact on mathematics teaching.

Table 3. Summary of Analysis of covariance post test of card game and conventional method of learning substitution

Test	Sum Of Squares	df	Mean Square	F	p
Regression	6175.68	1	6175.68	12.88	0.013*
Residual	23966.84	199	120.44		
Total	30142.52	200			

* Significant @ 0.05

Research Question Two

The second research question sought to assess if there were gender differences between students treated with OBG and those treated with traditional method of learning substitution?

Table 4 shows that f (2,193) = .85, & .72@ p = .35 & .42 both not significant. This implies that gender has no significant influence on the performance of learners in either with the used of OBG or MAT as a tool of facilitating and assessing teaching of mathematics respectively.

Table 4. Analysis of Covariance (ANCOVA) of students' achievement scores

Source Of Variation	Sum Of Squares	df	Mean Square	F	p	Decision @ 0.05
Covariate (Pre Test)	3187.28	1	3187.28	14.22	.00	S
Obg	2116.01	1	2116.01	13.09	.00	S
Mat	1063.46	1	1063.46	8.81	.14	Ns
Obg* Gender	390.32	2	195.16	.85	.35	Ns
Mat* Gender	371.94	2	185.97	.72	.42	Ns
Explained	7129.01	7	1018.43			
Residual	5382.81	193	27.89			
Total	12511.82	200	62.56			

s = Significant @ 0.05; Ns = Not significant @ 0.05

Discussion and Conclusion

Research has shown that the goals and rules adopted by learners during a learning task influence both their performance and their motivation (Brophy, 2006). Evidence from the findings of this study reveals that OBG has significant effect on students' performance in Mathematics. Group A (experimental group) had a higher mean scores than the group B that were taught the same learning content with conventional method. These findings were in support with other researches which determined that, understanding goals and rules supports student cognitive development, especially organizational skill and abstract thinking. To learn basic rudimentary Mathematics, students must, with quality instruction, master basic skills in arithmetic operations simple equations, inverse equation etc. (Hoon, chong & Binti Ngah, 2010). The study shows that learners had developed mental structure required in the game to understand the underlying concepts of the game including its goals/rules, properties and conditions. Research has also shown that gaming process may be an optimal teaching and learning approach to facilitate student learning of skills in Mathematics (Miller & Robertson, 2010). Although these findings were a bit different from the view of Onwioduokit and Akinbobola (2005), who assessed the efficacy of pictorial and written advance organizers to improve learners' performance. They found that pictorial organizer is more effective in enhancing students' performance than written organizer.

The results of this study also showed that gender had no significant impact on the performance between male and female students in the two groups (experimental and control groups). The findings of this study were in line with the findings of researchers who had also been interested in the differential effects of games between gender groups. While several studies have reported various gender differences in the preferences of OBG and computer game (Kinzie & Joseph, 2008). A few studies have indicated no significant differential impart of OBG between genders (Vogel, et al. 2006). Till date the studies examining IOBG, computer game and gender interaction are far from conclusive.

Implications for classroom practices

The mathematics cards game used for the study was an alternative way of teaching and a positive change that took the students away from pencil and paper. The games had an experiential nature which allowed the students to interact with the familiar environments in the games and construct their mathematical concepts through completing game missions.

While the comparisons between the experimental and control groups and pre- to post test changes provide, at best, modest evidence of the effectiveness of the game, findings from the treatment variations may suggest features to explore in the design of learning games, specifically variations in feedback and incentives.

One of the concern in the use of incentives in this study was the use of negative reinforcement; that is giving back some "lost points" if feedback was sought after an error rather than a more straight forward reward of positive behavior. In contrast to this procedure, positive incentives are consistent with research on the use of rewards for learning following desired behaviors (Holland & Skinner, 1961). A study that provided positive incentives may be more worth exploration. As asserted by Sulhman, (1986) that good pedagogical process in class must involve presenting the learners with enabling learning situations. The situations in which learners experiences in the broadest sense by try things out to see what happens, manipulate: figures, cards, pose questions and seek their own answers.

The use of mathematics card games like the one design for this study in the classroom increased students' engagement and involvement throughout their learning. An instructional Object Game used in this study created a classroom culture where students are more comfortable sharing their thinking about math concepts, whether right or wrong. This could be with his or her partner, or with the whole class. This culture was facilitated as a result of their learning even with difficult math concepts through playing games. Not only did the amount of math talk increase, but also students were more relaxed and less anxious about making mistakes while playing game.

Teaching various math concepts through playing games will give students numerous opportunities to work cooperatively with each other. According to Johnson and Johnson (1990), cooperative learning exists when students are working together to achieve a specific shared goal. The goal of the team is not only for each student to learn the math, but to ensure that all group members are successful as well.

References

Agosto, D.E. (2009). Girls and Gaming: a summary of the research with implications for practice. Teacher Librarian, 31(3), 8- 14.

Amory, A. (2007). Game object model version II: A theoretical framework for educational game development. Educational Technology, Research and Development, 55(1), 51-77.

Amory, A., Naicker, K., Vincent, J. & Adams, C. (1999).The use of computer games as an educational tool: 1, identification of appropriate game type and game element. British Journal of educational Technology systems, 24, 195-205.

Annetta, L., Mangrum, J., Holmes, S., Collazo, K., & Cheng, M.T. (2009). Bridging reality to virtual reality: Investigating gender effect and student engagement on learning through video game play in an elementary school classroom. International Journal of Science Education, 31(8), 1091- 1113.

Asim, A.E. (2007). Examination ethics and school based assessments in science, technology and mathematics: A critical concern for universal basic education. Proceedings of the 9th National Conference of National Association of Evaluators and Researchers. Nigeria, Ago-Iwoye.

Asim, A.E., Kalu, I. M., Idaka, I.E., & Bassey, S.W. (2009). Competency in STM assessment: The case of primary school teachers in cross River state, Nigeria. Proceedings of international Conference to Review Research in science, Technology and Mathematics Education (episteme-2), Feb. 12- 15, Mumbai, India.

Asimeng- Boahene, L. (2010). Gender inequality in Science Mathematics education in Africa: The causes, consequences and solution. Unpublished seminal paper.

Berson, M. I., & Bayata, P.(2010). Technological thinking and practice in the social studies: Transcending the tumultuous adolescence of reform. Journal of computing in teacher education 20(4), 141-150.

Bloom, B. S. (1959): Taxonomy of Educational objectives, Handbook cognitive New York David. Domain, Mckay Group Inc.

Chandra, V. & Lioyd, M. (2008). The methodological nettle: ICT and Student Achievement. British Journal of Educational Technology, 39, (6) 1089-98.

Corbeil, P. (1999). Learning from the children; practical and Theoretical Reflections on playing and learning simulation and Gaming, 30(2), 163-180.

Cox, S. (2008). A conceptual analysis of technological pedagogical content knowledge. Unpublished doctoral dissertation. Brigham Young University.

Cuban, L. (2008). Hugging the middle: How teachers teach in an era of testing and accountability. New York: Teachers college press. Design-Based Research collective. An emerging paradigm for educational inquiry. Educational Researcher. 32(1), 5-8.

Doering, A., Veletsianos, G., & Scharber, C. (2007b). Coming of age: Research and Pedagogy on geospatial technologies within K-12 social studies education. In A. J. Milson & Alibrandi, M. (Eds.), Digital geography: Geo-spatial technologies in the social studies classroom (pp. 213-226). Chariotte, NC: Information Age publishing.

Doyle, K.(2010).Academic work. Review of Educational Research 53,159-199.

Eke, E. (1986). Causes of students' underachievement in science, proceedings of the 27th Annual Conference of the Science Teachers' Association of Nigeria, pp47-56.

Fillier, K. (2009). Math Anxiety: Strategies for Preventing, Reducing, and Overcoming the Problem. Faculty of Ed. Submitted to Professor Robert Kelly of Memorial University of Newfoundland.

Friendman, A. M., & Hicks, D. (2010). The state of the field: Technology, Social Studies and Teacher Education. Contemporary issues in Technology and Teacher Education, 6(2). From http:// www.citejournal.org/vol4/iss3/general/article.2.cfm . Retrieved February 13th, 2012.

Gee, J.P. (2009). Why are video games good for learning ? from http:// www.academiccolab.org/resources/documents/MacArthur.pdf. Retrieved January 16th, 2012.

Grifth, S.A. (2005). Assuring fairness in school-based assessment: mapping the boundaries of teachers' involvement. Paper presented at the 31st Annual conference of International Association.

Haertel, C. D. et al. (1991). Early Adolescent Sex Differences in science learning: Evidence from National Assessment of Education Progress. American Educational Research Journal. 18(3), 329-340.

Hartmann,T., & Klimmt, C.(2010). Gender and Computer Games: Exploring females' dislikes. Journal of computer- mediated communication, 11(4), 910- 931.

Hoon, T. S., Chong, T. S. & Bintin Ngah, N. A. (2010). Effect of an interactive social game environment. British Journal of Educational Technology, 38, 3, 455 – 464.

Johnson, D.W. & Johnson, R.T. (2011).Learning Mathematics and cooperative Learning, Lesson plans for Teachers, Minnesota: Interactive Book Company.

Kinzie, M. & Joseph, D. (2008).Gender differences in game activity preferences of middle school children: implications for educational game design. Educational Technology Research and Development, 56 (5), 643-663.

Ke, F.(2008).A case study of computer gaming for math: Engaged Learning from game play? Computer and Education, 51(4), 1609-1620.

Ke, F., & Grabowski, B. (2007). Game playing for math's learning: Cooperative or not? British Journal of Educational Technology, 38(2), 249-259.

Kinzie, M. & Joseph, D. (2008).Gender differences in game activity preferences of middle school children: implications for educational game design. Educational Technology Research and Development, 56 (5), 643-663.

Martorella, P. (2005). Technology and Social Studies: Which way to the sleeping giant? Theory and Research in social Education, 25 (4), 511-514.

Miller, D. J. & Robertson, D.P. (2010). Using a games console in the primary classroom: Effects of "Brain Training" Programme on computation and self-esteem. British Journal of Education Technology, 41,(2) 242 – 255.

Oblinger, D.G. (2010).Games and Learning. EDUCASE Quarterly, 29(3), 5-7.

Olatoye, M. A. (2002). Computer - Based Instruction in Primary Schools: A case for Mathematics and English. Educational Perspective: A Journal of the Faculty of Education, Lagos State University. Lagos, Nigeria. 5 (2), pp28-32.

Onwioduokit, F. A & Akinbobola, A. O. (2005). Effects of pictorial and written advance organizers on students' achievement in senior secondary school physics. JSTAN 40 (1 & 2) 109 – 116.

Rieber, L. P. (1996). Seriously considering play; Design interaction learning environments based on the blending of microworlds, simulations and games. Educational Technology Research and development, 44(1), 43-58.

Ross, E. (2010). The Promise and Perils of e-Learning. Theory and Research in social Education, 28 (4), 482-492. Shulman, L. S. (1987). Knowledge and teaching: Foundation of the new reform. Harvard Educational Review, 57(1), 1- 22.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4-14.

Singh, K. Granville, M., & Dika, S. (2002). Mathematics and science achievement effects of motivation, interest, and academic engagement. Journal of Educational Research, 95(6), 323-332.

Swan, K. O., & Hofer, M. (2008). Technology and social studies. In L. S. Levstik & C. A. Tyson (Eds.), Handbook of research in social studies education (pp. 307-326). New York: Routledge

Vogel, J.J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2006). Computer gaming and interactive simulations for learning: A meta-analysis. Journal of Educational computing Research, 34(3), 229 – 243.

Watson, A. & Sullivan, P. (2008). Teachers Learning About Tasks and Lesson. In D. Tirosha & Woods (Eds.). International hand book of mathematics teachers' education: Tools processes in mathematics Teacher Education. 2, 109-134 Rotterdam, the Netherlands: sense publication.

Yoloye, E.A. (2008). Students' gender and science achievement: Historical Perspectives and their present and future practice. In Naido, P., & Savage, M. (Eds.), African Science and Technology in the millennium, Cape Town: Junta & co.