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Structured Instructional Process And Performance of Junior Secondary School 2 Students in Mathematics

(Proses Pengajaran Berstruktur dan Prestasi Pelajar Sekolah Menengah Rendah 2 dalam Matematik)

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ABSTRACT

This study examined the effectiveness and efficiency of using structured instructional process in teaching and learning substitution. The structured instructional process (object based card games) was compared with convention teaching methods in promoting achievement outcomes. A total of 120 Junior Secondary Schools II students (JSS2) drawn from three schools in three educational zones of Lagos state, Nigeria and three Mathematics teachers participated in this study. A mixed method of quantitative and qualitative was used with Analysis of Co-variance to analyse the data. Three research questions guided the study. The study was a pre and post test equivalent control group design. The results of the study showed that the treatments (Structured Instructional Object Based Games (SIOBG)) improved the subjects in grades and gained in knowledge over and above control group, that were exposed to the conventional methods. Gender and academic ability were not found to be significantly interacting with treatment.

Keywords: Structured instructional, object based games, learner's needs model and forms of technology of instruction, learning instruction, sex and ability

ABSTRAK

Kajian ini adalah untuk mengkaji keberkesanan dan kecekapan menggunakan proses pengajaran berstruktur dalam pengajaran dan pembelajaran penggantian. Proses pengajaran berstruktur (permainan kad berasaskan objek) dibandingkan dengan kaedah pengajaran konvensional dalam mempromosikan hasil pencapaian. Seramai 120 pelajar Sekolah Menengah Rendah yang terdiri daripada tiga sekolah di tiga zon pendidikan di negeri Lagos, Nigeria dan tiga guru matematik telah mengambil bahagian dalam kajian ini. Kaedah bercampur kuantitatif dan kualitatif digunakan dengan analisis varians ko-varians untuk menganalisis data. Tiga soalan kajian digunakan dalam kajian ini. Kajian ini menggunakan reka bentuk kumpulan kawalan ujian pra dan ujian pasca. Hasil kajian menunjukkan bahawa rawatan Permainan Objektif Pengajaran Berstruktur meningkatkan pencapaian responden kajian dari segi gred dan memperoleh lebih banyak pengetahuan berbanding dari kumpulan kawalan yang terdedah kepada kaedah konvensional. Keupayaan jantina dan akademik dalam kumpulan rawatan tidak menunjukkan hubungan yang signifikan ketika berinteraksi.

Kata kunci: Pengajaran berstruktur, permainan berasaskan objek, model keperluan pelajar dan bentuk teknologi pengajaran, pengajaran pembelajaran, seks dan kemampuan

Introduction

Programmed instruction, computer assisted instruction and computer aided instruction are instructional technology and computer instruction cum object based instructional strategies emerged as teaching methods since late 1990's in most public secondary schools in Nigeria. In recent time, teaching methods adopted in public and some private schools had become grossly inadequate to handle the needs of the learners. The delivery system and instructional strategies are considered to be ineffective, obsolete, and inefficient to solve pedagogical objectives among developing nations, particularly Nigeria (Chandra & Lioyd 2008). Scholars in the area of pedagogy and curriculum instruction blame the adoption of western curricula and methods of teaching that failed to address continental challenges (Asim, et. al. 2009). Olatoye (2014) submitted that, the consequence of adopted and direct transfer of western curricula in sciences and Mathematics decontextualised Nigerian pedagogical objectives. These were among factors identified by Asimeng-Boaheene (2010) that contributed to low academic performance in Mathematics both in certificate and non certificate examination.

According to Olatoye (2014b) the scrutiny of how well students are learning depends heavily on the instructional effectiveness. Instructional effectiveness in this context is the act or skill in the organization of pedagogy, content and knowledge of subject matter that does not devoid adequate technology of instruction.

Shulman (1986) asserts teaching as an act that involves knowing how to take advantage of different teaching approaches so as to facilitate a learning experience most suitable for the learners. The variances of instructional strategies and adoption of useful technology of instruction became a necessity to address the present day vague and drill Mathematics teaching that dominated both private and public schools in Nigeria. This calls for incorporation of self motivating experience scene such as structured instructions that are object based. This structured instructional approach adopted for this study involves integrate content- specific technologies. That is problem based learning. These methods were grounded in technology of instruction framework to help every individual who is lacking in coping with conventional teaching methods due to certain external factors. These are factors militating against the meaningfulness of the traditional teaching methods as identified by Olatoye (2002) in learner's needs model among the learners' in public schools in most developing nations like Nigeria. He classified them as external factors such include lack of appropriate nutrition (food) from home before going to school, peer pressure, lack of parental care, etc. This model expressed the use of technology as instructional tool with adequate pedagogy (adoption of teaching methods), well defined contents without clumsy clauses, sensitivities of learners outcome through adequate evaluation procedure.

Technology of Instruction: This is an act of using modern electronic, electrical and non electronic (object based) devices such as internet, computer set, skyp, video and audio (conferencing), realer, cards, charts etc to enhance meaningful, effective and efficient teaching and learning process. Forms of Technology of Instruction: (1)Electronic and electrical forms: these involve the use of programmed based instruction incorporated with computer gadget or compact disk (CD) with CD player or projector in teaching (2) Object based forms include the use of real object, realer, object based materials such as such as LUDO or ACE cards used in teaching probability.

For the purpose of this study, designed object based card game was used. It was however, argued that the controversial nature of structured instruction dictates the use of value fair setting but not necessarily used in autism cases only. As identified by Olatoye et al. (2014) that structured instructional object based provides learners with range of options that lead to the development of knowledge, attitudes, and dexterity skills needed to boost domains of learning. This presupposes that 'traditional or conventional' methods like lecture, exposition are less comparative value in teaching and learning, They promote passive and formalistic acquisition of meaningless facts which are painfully learned and forgotten easily, their use should be minimized. The presumption has not been well grounded in empirical investigation on the use of structured instructional (Olatoye 2002).

Yoloye (2008) reported some findings in support of the relative superiority of constructivist or problem based learning as indicated in this study over traditional methods. But report of Horoks and Robert (2007) found no significant difference in the acquisition of facts between those taught by inquiring and exposition methods. Though there are so many recent studies that tend to support the superimases of learner centered approaches in teaching and learning. These consistent findings emphasized the effectiveness of structured instructional strategies in achieving certain instructional goals (Kromrey & Purdom 1995).

Learning Mathematics for understanding requires teachers to have some knowledge concerning the epistemological, didactical and cognitive components of the subject they teach (Bartolini-Bussi & Maschietto 2008). Mathematics tasks are what learners are asked to do to initiate an activity, the purpose of which is to stimulate thinking and reasoning. Such tasks are the backbone of a Mathematics lesson as they determine the success and failure to achieve the objectives of the lesson. Literature shows that different types of Mathematics tasks prompt different kinds of activities compelling that; the design of activities (such as gaming structured within Technological Pedagogical and Content Knowledge (TPACK) principles are significant in Mathematics learning (Horoks & Robert 2007). There is need however, for activity and experimental learning through constructive pedagogical content knowledge delivered through activities such as gaming. Gaming that was designed for this research work was an innovative, technological integration and experimental learning process, packaged with TPACK principles without generic or gender bias.

Research on gender differences and preferences on the use of gaming in learning was in conclusive. Previous studies carried out by Hartmann and Klimmt (2010), showed that female students were less attracted to competitive games. While separate studies carried out by Annetta et al. (2009) and Vogel et al. (2006) found no significant differences in examining the effect of games on Mathematics achievement (by gender, ability and attitude) in game classroom environments. There is need to conduct research on the use of alternative student centre approaches in the teaching of Mathematics in Nigerian schools so as to provide students with deeper learning experiences. The investigator has identified gaming as innovative technology of instruction used in the teaching of Mathematics as compared to the traditional approaches currently used in the school system.

Statement of yhe Problem

Many Nigerian schools at both primary and secondary levels are facing an epidemic that could be referred as math-phobia, (i.e. an extreme fear of teaching and learning Mathematics) (Fillier 2009). Students have developed

this phobia and, in turn, struggle learning various concepts. Teachers also struggle to teach directly from textbooks because there are no teaching resources, where resources are available, they lack pedigree. This situation increases anxiety and as anxiety increases so the academic performance and achievement inevitably decreases (Fillier 2009). There is need to use technological based driven process suggested by this study.

Purpose of the Study

This study was conducted to determine the relative effectiveness of structured instructional methods compare with conventional methods (lecture and exposition) in teaching J.S.S II students in Mathematics (with selected topics in indices, standard form, fractions and simple equations, these were pulled together to form substitution object card game).The study also determines interaction effects of learners ability and gender on the performance in Mathematics outcomes when alternative methods were used. Mathematics was specifically picked because of its significant relationship with other subjects and emphasis place on it by Nigerian curriculum. It was hope that this study would provide useful insight into those instructional strategies suitable for improving performance of students in Mathematics in Nigeria particularly in Lagos state. Though there are several variables affecting students performance in learning Mathematics apart from teaching methods; have identified gender and learners' ability as two main learners characteristics in explaining Mathematics learning outcomes. These variables were therefore built into the experiments in order to investigate their interaction effects on the identified instructional methods.

Research Questions

1. What is the composite was performance of learners treated with structured instructional object based card game?
2. Are there effects of ability on the post test mean scores of academic ability of the subjects treated with structured instructional object based card game?
3. What is the interaction effect of gender on the treated groups?

Methodology

Design of Study

This study used the combination of quantitative and qualitative instruments to collect data. The quantitative instruments enhanced the researcher examine the impact of the game on the large scale of the subjects in other to facilitate the possibility of generalization of the findings The qualitative data helped to cross validate the results of quantitative results and explore the cause of the game impacts .Quasi- experimental research design was used as suggested by Kerlinger and Lee (2001). This involves experimental group (subjects in this group were treated with structured Instructional card game) and control group (subjects in this group were treated with traditional methods of teaching). Baseline data were collected through pretest from the two groups. Also in the study, multi stage stratified convenience sampling (is an applied sampling method where many stratified sampling were used for convenience because the subjects from each stratum were represented in the same proportion from different educational zones.) was used.

The sampling was multi stage because the schools in Education district III were divided into three zones. Three schools were selected, each from a zone. The criteria of picking the school include: mixed school or co-educational schools (school where male and female students attend), facilities to play card games, such as movable chairs and table, if the school has qualified mathematics teacher and if s/he (teacher) is ready to participate in the research process. Forty (40) subjects were selected from each school out of the three (3) schools selected at education district III (convenience selection) to make the total number of one hundred and twenty (120) subjects. The selected subjects were divided into two groups (experimental and control groups).

TABLE 1. Gender distribution according to study groups

Group	Gender		Total
	Male	Female	
Experimental			
Control			
Total	60	60	120

The same features characterized the two (2) groups see distribution as specified in Table 1. Using table of random number, whereby the subjects were arranged and numbered in odd and even order. The selection was in ratio one to one, that is, the subjects with odd numbers were assigned as control group and subjects with even numbers were assigned to experimental group in each school. The selection process also balanced for ability levels (above average, average, and below average) for the two groups having gone through their anecdotal records. In each selected school one Mathematics teacher was picked to have three teachers in all. The criteria of picking the teachers include: five (5) years teaching experience. She/he should be a qualified teacher with minimum of B.Sc(Ed) or B.Sc with P.G.D.E in Mathematic, and the selected teachers were trained and undergone training on the use of the design instruments, content presentation, strategies, and logistic involves in conditioning the teaching activities.

MATHEMATICS ACHIEVEMENT TEST (MAT)

Mathematics Achievement Test was constructed as type A and B, and was used to collect information on students' performance before and after treatment. The test items were represented as the cognitive interface of the cards. The test was based on the algebraic substitution (simple equation, linear substitution, inverse operation and quadratic substitutions). The test had thirty essay test items constructed based on the table of specification in Appendix A. The test items were structured around all cognitive levels of Bloom taxonomy of learning.

CARD GAME

The design card game was administered to the experimental group. Each of the members of the group was scored according to his/her responses, the scoring is specified below.

Scoring Format. Card games and MAT were scored using interval scale of three (3) points. Each player records every play card score at the end of every game play. The score a player had on every card was scored as three points, the scores for all the cards played by a player were summed up at the end of the game and these (scores) were transferred to appropriate column against the number given to every subject in this group. The scoring pattern follows Likert scales format designed for this purpose and was used for coding responses of the subjects treated with card games.

MAT was scored on one question to three points, whereby every member of the control group who solves the given task and got the answer was given three points for each question. One and half point for working only and correct answer respectively, the total score was transferred to appropriate column against the number given to every subject in the group.

JSS 1 (1^{st}, 2^{nd} and 3^{rd} terms) Mathematics scores (Performance) of all the subjects were collected for the two groups (experimental and control groups) average of 1^{st}, 2^{nd} and 3rd terms scores were calculated. This average score represent learner's previous performance and Scores obtained in pre and post tests of the Card Games and MAT were also transferred to appropriate column against the number given to every subject for further analysis. JSS 1 Mathematics scores (previous performance) of the subjects were correlated with the performance on the given items. The sum of previous performance, pre test and post test formed learner's ability. This was used to confirm change in every learner's performance, positively or otherwise.

PROCEDURE FOR THE GENERATION OF INFORMATION THROUGH QUALITATIVE DATA

After determining the subjects and participating schools, arrangement was made with the principals and Mathematics teachers in the schools used for the study. Two days training were given to the teachers according to the treatment condition. This training however consisted of:

1. Classroom arrangement: involves arrangement of chairs and tables for the experimental group for the ease administration of the design card game.
2. Method of assessment of the card game, and MAT as specified on scoring format.
3. Designing the lesson plan: Involves taking the teachers through the contents of the design card game and MAT. Also included was presentation of contents and evaluation of learning activities.
4. Teaching the use of instruments (design games, and MAT) and ascertain the proper application and use of the instruments (design games and MAT).
5. The scope of the objectives for each lesson.

PRE AND POST TESTS ACTIVITIES

Pre-Test. Before teaching activities pre test was conducted. The selected subjects for the two groups participated and were given the same test items. The test contains 30 (thirty) multiple choice items and five essay questions with fifty minutes allocated on each paper for the response of the test items by the subject. The pre test was conducted by the researcher and three research assistants. The responses of the subjects to the test were collected, marked and analyzed appropriately.

Post Test. After the test was conducted. The responses of the selected subjects of the two groups were collected, marked and analyzed appropriately**.** While the researcher monitor the conduct and administration of both the pre-test and post-test to ascertain the same condition of test administration. All the subjects were given snacks and soft drinks before the treatments so as to prevents external factors (these are conditions that militate against meaningful learning such as malnutrition, broken home effect, peer pressure, etc while malnutrition is the main factor) influencing the subject, as suggested by Olatoye, (2002) in learner's needs model (intervening variable).

DETAILED PROCEDURE FOR THE CARD GAMES BASED EXPERIMENTAL GROUP

The treatments in the experimental group followed these steps:

1. Teacher briefly went over the previous topic treated a day before, and then introduced the topic for that day that was substitution. Then cards (design card game) were distributed according to guidelines provided for the game and re-arrangement of the class. This was followed by explanation on the use of the card game in accordance with the design.
2. Activity session: involves students' playing card game with minimum teacher intervention.

3. De-briefing, assignment session, collection of materials and re-arrangement of class.
4. This treatment lasted for two weeks with instruction given for two periods of thirty minutes each in the whole of sample schools for the study.

PROCEDURE FOR THE CONVENTIONAL METHOD I.E. CONTROL GROUP

The procedures for the conventional method are as follow: The teachers taught and explained the topic to the students. Here the teacher solved related questions extracted from mathematics textbooks on the chalkboard, while students took down the notes, did the class work, ask questions when confused and copy homework. This was given for two periods of thirty minutes each for two weeks in the sample schools chosen for the study after which MAT was administered to the control group three months later.

PROCEDURE FOR THE GENERATION OF INFORMATION THROUGH QUANTITATIVE DATA

Responses from the instruments were scored as specified on a five point (Likert scale) while nominal values 1, 2, 3, 4, 5 were assigned for SPSS coding thus: (a) previous performance of subjects (JSS1), (b) pre – test (c) post test were rated 0 – 39, 40 – 49, 50 – 59, 60 – 69, 70 and above assigned nominal values 1,2,3,4,5 respectively. Only experimenter group was administered with card game. The pre tests were carried out at the beginning of second term while post test on the instruments comes up three months after. Responses from the subjects according to card game and MAT were scored.

Data Preparation. Data were prepared and collected from the instruments as follow:

1. Cards game was played by two players and each player record score of every card played while the total score of every player was rated by the nominal value. The play activities came up for pre and post test in the chosen schools in the zone (educational). The players of the card game had the same features with control group.
2. MAT: Control group was administered with MAT while experimenter groups played card at the same time in the class. The responses of MAT from pre and post tests were graded as specified above, data obtained were further coded. The codified responses from the two groups were processed using Statistical Package for Social Sciences (SPSS) version 21. Each of the group responses after scoring and coding were computed into mean values, standard deviation, analysis of covariant, Pearson correlation coefficient and two way analysis of variance at .05 significant levels. The teaching materials used are summarized below.

STRUCTURED INSTRUCTIONAL OBJECT BASED CARD GAME

The game cards were designed in line with TPACK principles that is 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 $Y= 3^x + 3x$ in Figure 1. Abstract interfaces refer to all pedagogical and theoretical constructs from Figure 1; 2 (two) that appears as identified is the abstract interface of the sample card. The card contents area or cognitive levels were structured by using Bloom (1959) taxonomy of knowledge.

PROTOTYPE OF GAME DESIGN (TPACK PRINCIPLES)

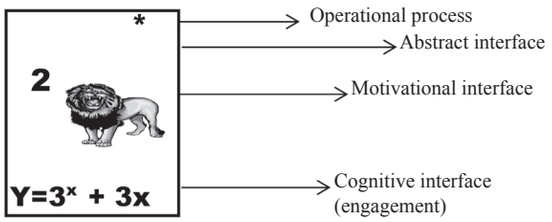

FIGURE 1. Substitution card game using TPACK principles

1. The first player plays on the assumed card value of the playing card.
2. Operation is based on *face* value of the last played card for subsequent play.
3. The use of calculator is allowed in computing only the final result.

The Goal. The goal is to substitute the number in the middle of the card for X in the equation at the bottom of the card surface, to be able to have the value of the card and also use arithmetic operation at the top right edge of the card to relate with other card on the playing board. If the substitution is form correctly Y gives the value of the card and player uses this value and arithmetic operation in his card to play the card on board then he has his score. The player can move on to another card. Example:

The middle number that appears on each card represents X, which is substituted for in the equation at the bottom of the card. T o determine the value of the card, see Figure 1 above. The first card has the value of $Y = 3^2) + (3)2 = 9 + 6 = 15$. The arithmetic operation at the right top edge of the corner of each card is used as operating factor between two cards.

How to Play the Game. The number of the players shall be two and above. The players shall combine the three functions on the card to determine the scores of the player(s).

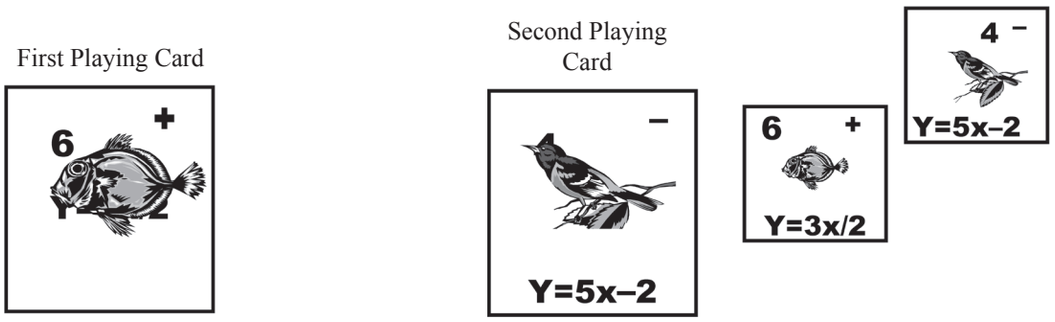

FIGURE 2. How to play the card game pattern

X equals to the bold number on the card. The number is substituted in place of x in equation at the bottom of the card to give score of 9 i.e.

$Y=\frac{3x6}{2} = 9$

The second playing card has the value of the card to be Y = 5(4)-2 = 18 but met +9 on board therefore the score will be 9+18= 27

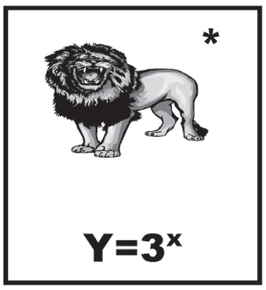

FIGURE 3. Third playing card

Third Playing Card. The 3rd playing card has the value of 27 but meets 18 on board. Using-operation on the second playing card, one plays 18 and 27 i.e. 18 - 27 = -9.

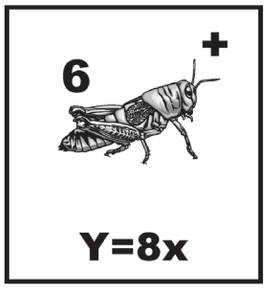

FIGURE 4: Fourth playing card

Fourth Playing Card. The 4th playing card has the value of his card to be 48 and meets 0 (zero) on board. Therefore his score will be 48*27 =1296.

THE OUTCOMES

The outcomes allow visualization and comparison of scores, this motivates the players to proceed on the next play card until the whole cards are extorted. Positive feedback and rewards are given such as attractive winning scores. If an improper operation is formed, the player fails to play further or having negative results all through.

Traditional or Conventional Methods. This was administered to control group. The purpose was to assess the impact of students contribution in learning substitution lessons, that focus teacher teaching and students: listen, asked questions and answered questions asked by the teacher while he teaches. This process was divided into three stages: introduction, presentation and conclusion. Introduction focused on the 'springboard' together with teacher explanations as in the case of teaching sub topics under substitution as specified above. Under presentation, teaching activities that involves teacher in explaining the sub topic and students taken note of teacher explanations, they (students) response to the evaluation either verbal or written. In conclusion, teacher recapitulates questions that were mainly factual and probe within the topics raised during the teaching process.

RESULTS

RESEARCH QUESTION 1

What is the composite performance of learners treated with structured instructional object based card game?

To answer this question, mean scores counts and the standard deviation scores of the responses were calculated (see Table 2). The descriptive analysis shows that the mean scores and the post test standard deviation for the treatment group were 34.38, and 4.20 against 25.03 and 3.13 for the control group. The findings suggested that the experimental group had higher mean score than the control group with lesser mean score and the standard deviation. These were in line with the results of the Analysis of Covariance (ANCOVA) on post-test scores of subjects according to Treatment Groups, Sex and Academic ability

(Table 3). In the Table, the treatment (F = 23.969; P< 0.05) is statistically significant that is F (2, 119) = 23.969; p = .000 (model 1). Therefore, the first research question can be answered by saying the learners that were treated with structured instructional card game perform significantly well than those treated with traditional or conventional method despite pre test being insignificant @ F (2, 119) = 56.588; p = .600 @ > 0.05.

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

Criteria	Card Game Method	Traditional Method
No of cases	60	60
Pre test mean	19.11	18.26
Post test mean	34.38	25.03
Mean gain	15.27	6 .77
Pre test Standard Deviation	2.62	2. 19
Post test Standard Deviati	4.20	3. 13

RESEARCH QUESTION 2

Are there effects of ability on the post test mean scores of academic ability of the subjects treated with structured instructional object based card game?

To answer this question, ANCOVA results showed in Table 3, F (1, 119) =27.707, p = .000 (model 2) @ p < .05, ability is statistically significant. This implies that ability as an entity contributed to the performance of the learners. But when ability interacted with the treatment, the result indicated that F (2, 119) = 1.579, p = .241 @ p > .05 is not statistically significant. Therefore, ability does not have any effects with subjects treated with structured instructional object based card game.

RESEARCH QUESTION 3

What is the interaction effect of gender on the treated groups?

In testing and providing answers to the third research question, Table 3 shows that F (2, 119) =1.638, p = .296 (model 3) that is @ p > .05. This implies that, when gender interacted with treatment is not statistically significant. Also as a single entity F (1, 119) = 0.168, p = .592 @ p > .05, gender was not statistically significant also as a single variable. This therefore implies that gender as discrete variable had no significant effect on the learners' performance in structured card game.

Discussion of Findings

The main objectives of this study were to design, examine and assess the differential influences of Structured Instructional Object Based Card Game that was designed with TPACK principles on the performance of students in JSS 2 in Mathematics against the traditional teaching methods. And explore relationships among students' characteristics (ability and gender) towards the game and students learning in game environment as used in classroom practices. In the first analysis, the Model 1 examined the statistical significant differential effect of structured cards for the students of the experimental group. Evidence from the findings of this study revealed that students who played the math card games scored significantly higher than students who did not play the card game. The higher mean score of the treatment group was indicative of the effect of the treatment. This emphasis that the technology based strategy (structured card) had a positive effect on students performance in Mathematics. Experimental group had higher mean scores than the control group who were taught

TABLE 3. Summary of 2 x 2 x 3 analysis of covariance on post-test scores of subjects according to treatment groups, sex and academic ability

Source of Variation	Sum of Squares	df	Mean Squares	F-Ratio	P
Covariates pre-test	1539.200	2	769.600	56.588	.600
Main effects	1139.618	4	284.905	20.949	.000
Treatment	651.945	2	325.973	23.969	.000
Gender	2.283	1	2.283	0.168	.592
Academic ability	376.817	1	376.817	27.707	.000
2-way interaction	75.838	5	15.168	1.112	.371
Treatment x gender	41.631	2	20.816	1.638	.296
Treatment x ability	3 9.803	2	19.902	1.579	.241
Explained	2327.935	17	136.937		
Residual	1182.017	102	11.588		
Total	3509.952	119			

α is significant @ p < .005

the same learning contents with conventional method. These findings supported other empirical researches which determined that, to learn Mathematics, games engage students and give the learners opportunity to present "high level" math concepts in colorful ways that lead to increase math performance (Cavanagh, 2006). This study provided evidence that the structured instructional cards game used for the study influenced students Mathematics learning.

This study support claims made in previous literature that game technology based incorporating essential game features could be an effective learning tool for students to manage the acquisition of new information, depending on their prior knowledge and experience, learning progress, learning style, preferences and needs (Condie & Munro 2007; Cordova & Lepper 1996; McFarlane et al. 2002; Rosas et al. 2002). The results of this study are consistent with prior empirical research on the effectiveness of math games as teaching tools and learner centeredness, including those reported by Klawe (1998), Ke and Grabowski (2007), also Moreno (2002) suggesting that math games may improve mathematics achievements.

Wenglinsky (1998) examined the relationship that technology played on both the mathematics performance and academic achievement, measured by standardized tests as well as the social environment of the school, encompassing student tardiness, teacher and student absenteeism, student and teacher morale. He found that the use of computer learning games that required students to use higher order thinking skills positively affected academic achievement. He also found a positive relationship between teachers receiving professional development in the use of object based games and computer learning games to their students' academic achievement. The usage of games, technology, computer games assisted in higher order thinking skills and computer learning games help to increase student achievement as suggested by Wenglinsky (1998) and these findings were in line with the first model established in this study.

In addition, the positive achievement results of this study supported the learning effectiveness of the experiential nature of the treatment activities which can be retained to the experiential learning theory developed by Dewey (1938).The results of the present study however, revealed that participants' mathematics understandings and skills improved as a result of playing the mathematics card games. According to the results the students were given an alternative, effective teaching and learning tools (card games). The card games: (1) diminished students' mathematics phobia, (2) Offered mathematics in adventurous and exploratory context, (3) Combined learning and fun, (4) Challenged students to learn mathematics, (5) Collaborative nature of the games made the games more attractive for students to play and (6) Research has also showed that gaming process may be an optimal teaching and learning approach to facilitate student learning of skill. (Miller & Robertson 2010). Based on the results of this study, it can be concluded that the card game activity is beneficial to the students' indifference of learning ability of students. Though learning ability from the context of this study was observed as continuous variable where by ability of learners to respond to the card items was the major focus to this study.

In the third Model, there was no interactive differential effect between the gender and the treatment this was in line with Annentta, et al. (2009) view in a study where there was no significant gender difference in science achievement in examining the effect of games on the science achievement (treatment) of fifth (5^{th}) graders. Previous empirical views showed that, gender plays a role in technology integration and also that there is significant differences between males and females in terms of the ability to use technology (Agosto 2009; Hartmann & Klimmt 2010). The researcher believes that things have changed now because women can go for any type of job they like and there are definitely no gender restrictions in terms of technology use in schools.

Nevertheless, the results of the findings showed that the card games were effective teaching and learning tools because they (a) were experiential in nature, (b) offered an alternative way of teaching and learning, (c) gave the students reasons to learn mathematics to solve the game problems and progress in the games, (d) addressed students' mathematics phobias and (e) increased time on task. As identified through quantitative data collected that: "the card game makes them want to learn [math]."

Implications for Pedagogical Practices

The mathematics card games used for the study were 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 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. Games 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.

These findings are in consonance with those of Black (2007), Boud (2004) and Eisen (1999) who noted that peer learning involves sharing of ideas, knowledge and experiences as opposed to independent learning. It (peer learning) was viewed by constructivist theories of learning as a means of active individual construction and a process of enculturation into classroom practice using gaming process. However, this current study was in line with fore mentioned authors that using mathematics card games as peer learning tools develop learners ability to take control over their own learning. Also allow cooperation, communications, closeness, mutually and understanding of topic content due to intensity of the partnership.

Conclusion

The development of effective teaching strategies through adequate technological and pedagogical processes stems from the quest for optimizing students' learning outcomes in all school subjects particularly in mathematics. Effective and efficient instructional and pedagogical strategies in teaching mathematics have become pertinent because quality of education at all levels is measured in terms of students' learning outcomes. Students' learning outcomes in turn are seen as a function of quality of teaching to which students are exposed to.

Conndly (1999) opinion that, if what pupils learn is the basic output of schooling, the more students learn in a given time the more 'effective' is the teaching to which they are exposed. Today learners' test scores are regarded as an important operational measure of effective teaching. Effective teaching therefore, is a by- product of adequate instructional, pedagogical and technological processes. It is therefore necessary to revolutionized traditional teaching strategies since the later have been found least effective in enhancing learners' cognitive, psycomotive and affective performance in mathematics but card games do.

A number of important issues regarding the integration of games in school settings also emerged from the findings. To use the games effectively in school settings, it is believed that: Teacher training, focusing on the integration of games (e.g. what to do before and after game play, how to access and interpret students' scores, how game missions relate to course topic) is essential for enhancing student learning. Teachers, however, do not necessarily need to know how to play each game; students figure out game play on their own or help each other master game mechanics. Logistical issues across the school, including scheduling time and available games and other gaming accessories for students to play the games must be addressed prior to the school term to optimize use.

Recommendations

The study suggests that various learner characteristics should be considered when attempting to explore the effects of card game. Especially with the current result that indicated significant effect in learners ability. The significant effect which was found without considering various categories of learning ability. Effort should be made to categorize ability so as to further establish the learning impact on the low ability or below average learners of the performance level of the game. Also to distinguish between learning ability and item respond ability.

In addition to further studying the effects of math games on student math attitudes and motivation, additional data analyses and research are recommended, examining: The use of alternative pre-game and post-game instructional events on student game play and resulting math achievement and motivation. The differential use, preference and effects of single versus multiplayer games on student math achievement. The effects of fundamental game components and related game elements (e.g., characters settings, plot, rules, tools, goals, mechanics) on student math achievement

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APPENDIX A

Table of Specification

Content	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
Simple equation	1	2	2	1	1	1	8
Linear substitution	1	2	1	1	1	1	7
Inverse operation	2	1	2	1	1	1	8
Quadratic substitution	2	1	1	1	1	1	7
Total	6	6	6	4	4	4	30