EFFECTIVENESS OF COMPUTERISED MATHEMATICS GAME-BASED INSTRUCTION ON TIME MANAGEMENT OF STUDENTS WITH MATHEMATICS LEARNING DIFFICULTIES DURING EXAMINATIONS

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Abstract
Time management is very important in everything one engages in. To students, time is very important and it is an indicator of success or failure. In Mathematics, time management on the part of the students is very crucial. More importantly, in the era of technology innovation, time taken to complete a task is vital to academic achievement as instructional contents are adequately timed devoid of manipulation by students. It is on this note that this study explored the efficacy of computer Mathematics game based instruction on time management in examination by students with mathematics learning difficulties. The study employed experimental pre and posttest research design. Three hypotheses were formulated and a total number of 26 participants identified to have shown signs problems of time, space and Mathematics difficulties. The instrument used comprised of computerised Mathematics game based instruction adequately timed, Mathematics interest checklist and Mathematics achievement test with reliability of 0.70 and 0.75 respectively. Both experimental and control groups were pre and post tested. Data were analysed using mean, standard deviation and analysis of covariance. The results revealed significant main effects of treatment on time spent, also there was main effect of gender on time spent but no significant interaction effect between treatment and gender on time spent. Hence, it was recommended that digital based Mathematics game should be employed as pedagogical tool to motivate consciousness of time among students with Mathematics learning difficulties.

Keywords: *Computerised Mathematics game, Time management, Students with Mathematics learning difficulties, Examination*.

Introduction

Mathematics is one of the recognised compulsory subjects at elementary and secondary schools level in Nigeria. It is a subject required by students not minding their intended prospective specialisation before gaining entrance to higher institutions of learning. The importance of Mathematics in all facets of lives has made the subject the centre of every developmental agenda. Mathematics education provides individual with a wide perspective and knowledge to understand the world and enhance their social interaction and their skills (Sayan, 2015). The knowledge and basic skill provide by Mathematics help to analyse various experience, solve problem systematically, facilitate creative thinking and aesthetic development as well as development of reasoning ability and skills of individuals in various situation of life.

In spite of the importance and the dynamic application of Mathematics, there are numbers of factors militating against adequate skills acquisition in the subject. These factors comprised of difficulty in memorizing basic computational and arithmetic symbols, confusion of terminology and symbolic notation system of Mathematics, weak understanding of concepts due to visual-spatial organisation deficit (Garnett, 1998), self-efficacy and motivation (Chun-Ming, Iwen & Gwo-Jen, 2015), gender (Ajai and Imoko, 2014), the role of environment (Suan, 2014) as well as time management in the area of computational accuracy and basic skills in Mathematics within a limited period.

Time management plays a vital role in improving students' academic performance, achievement and task completed within a limit of instructional schedule (Nasrullah & Khan, 2015). The ability to manage time enhance goal achievement in all areas of live. In modern world, time is seen as an indefinitely divisible and usable commodity. The secret of achieving success in life depends on the effective management to time. All events of life happen with time. Time management is measured by available time, allocated time engaged time and pacing which relatively affect value and achievement of tasks. Allocated time is the amount of time assigned for instruction in a content area, without reference to quality of activities being conducted that time (Fisher, Behner, Filby, Mariliave, Cahen, & Disnaw, 1980), available time is the time available for all activities. The available time is limited by the number of days in a school year and number of hours in a school day (Brophy, 1986), engaged time is the amount of time the student is actually involved in such learning task as writing, listening and responding to teacher question (Brophy, 1986) and pacing is the rate at which teachers and students conduct and or engage in a instructional content. This is reflected in the number of second, minutes and hours individual use to complete a work. All these dimensions of time management affect achievement of tasks by students.

Mathematics as a subject involves high cognitive manipulation, effective and efficient understanding of pattern and dimension of computation accuracy as well as time management. The influence that these personal variables such as motivation and ability have on academic success are well documented but there is paucity of research investigating how students maximise time in a carrying out specific activity especially in very sensitive subject like Mathematics by high and low achieving students in the subject.

More importantly, the era of information and communication technology has added new dimension to academic successes and failure. The advancement and popularity of computer and multimedia technologies have encouraged researcher to develop digital contents and system for Mathematics (Chun-Ming, Iwen & Gwo-Jen, 2014). It is one of the recent evolutions in information and communication technologies. Computer game based instruction has been reported to have reduced students Mathematics anxiety, improve self-efficacy, motivation and reasoning (Chun-Ming, Iwen & Gwo-Jen, 2014; Kuo, 2007; Louis and Mistele, 2012; Peter, 2013).

It is imperative that if digital game based instruction could have achieved a lot in influencing affective and cognitive variables, its popularity in the management of time on students' activities and achievement in Mathematics can also be exployed. Nasrullah and Khan (2015) noted that time management play a vital role in improving students' academic performance and achievement. Every student no matter the level weakness should have time management ability which includes pacing, setting goal and priority. This is possible through self-motivation, ability and interest (Brigitte, Claessens, Earde & Rutte, 2005). Time management is directly related to the engage in performing a certain task. This is very important in Mathematics as this aids speed and reasoning ability of the students. Therefore, inability to manage time makes students to suffer disadvantage in subject that demand serious time consciousness like Mathematics. Adebayo (2015) noted that time management is as important as human and material resources. This she posited that poor time planners seem to be faced with low achievement, productivity, inefficiency, ineffectiveness, low morale, stress and frustration with themselves. Proper time management becomes important in education especially among students who may belief their achievement is influenced or affected by time taken to complete work. Though Omolara (2010) believed that time is always available but wait for no one and is no respecter of gender as both male and female are affected by time regard achievement.

While various strategies are being employed to improve academic performance or achievement in Mathematics of many individuals with Mathematics difficulty, the issue of time taken or management has not been seriously considered as one of the key factor to success and failure in Mathematics among students. It is therefore imperative to examine time as one of the predictors of academic achievement of some students with Mathematics difficulty. Therefore, this study is on the effect of computer-based Mathematics game on time management examination by some students with Mathematics learning difficulties in Lagos State.

Purpose of the Study

The main purpose of this study is to determine efficacy of computer mathematics game based instruction on time management in examination by students with mathematics learning difficulties. Specifically, the study sought to:

(i) examine the main effects of treatment on time spent by participants in algebra examination;
(ii) find out the extent to which the gender of the students would influence the time spent by them in Algebra examination; and
(iii) examine the interaction effects of treatment and gender on time spent by them in Algebra examination.

Research Hypotheses

Ho_1: There is no significant main effect of treatment on the time spent in Algebra examination by some identified Mathematics learning disabled students.
Ho_2: There is no significant main effect of gender on the time spent in Algebra examination by some identified mathematics learning disable students.
Ho_3: There is no significant interaction effect of treatment and gender on the time spent in Algebra examination by some identified mathematics learning disabled students

Methodology

This study employed pre-test, post-test non-equivalent control group design with experimental and control groups. The population for this study comprised Junior Secondary School 3 (JSS 3) students in Lagos state, Nigeria. The sample for this study comprised selected Junior Secondary School 3 (JSS 3) students in Federal College of Education (Technical) Akoka Staff School and Mighty Oaks Comprehensive high school lyana Ipaja. A purposive sampling technique was employed by the researchers to select the schools for this study. The schools were selected based on their (i) Accessibility, (ii) Willingness to participate in the study. The schools were situated far apart from each other hence removing the possibility of contamination. The participants were 26 (13 male and 13 female) students with trait of mathematics learning disability as identified after a mathematics interest checklist was administered. Their participation was based on availability and willingness to participate in the study.

The instruments used for this study comprised a purposely designed mathematics game in form of snake and ladder fashioned to teach Algebra, Mathematics Checklist and Mathematics Interest Checklist. The time spent by individual candidates in the Algebra examination was also recorded. The mathematics game was designed by a computer programmer: the game has the following procedure:

(i) Launch the game on your computer
(ii) Click on the start button of the game to activate it
(iii) Click on "role the dies" to display the dies rolled with an algebra problem, the number of the possible outcome of the disc is then substituted for the value expected in the algebra problem.

(iv) The result then determines the movement of the player on the snake and ladder game. The students were then introduced to how to use the game to solve algebra problems.

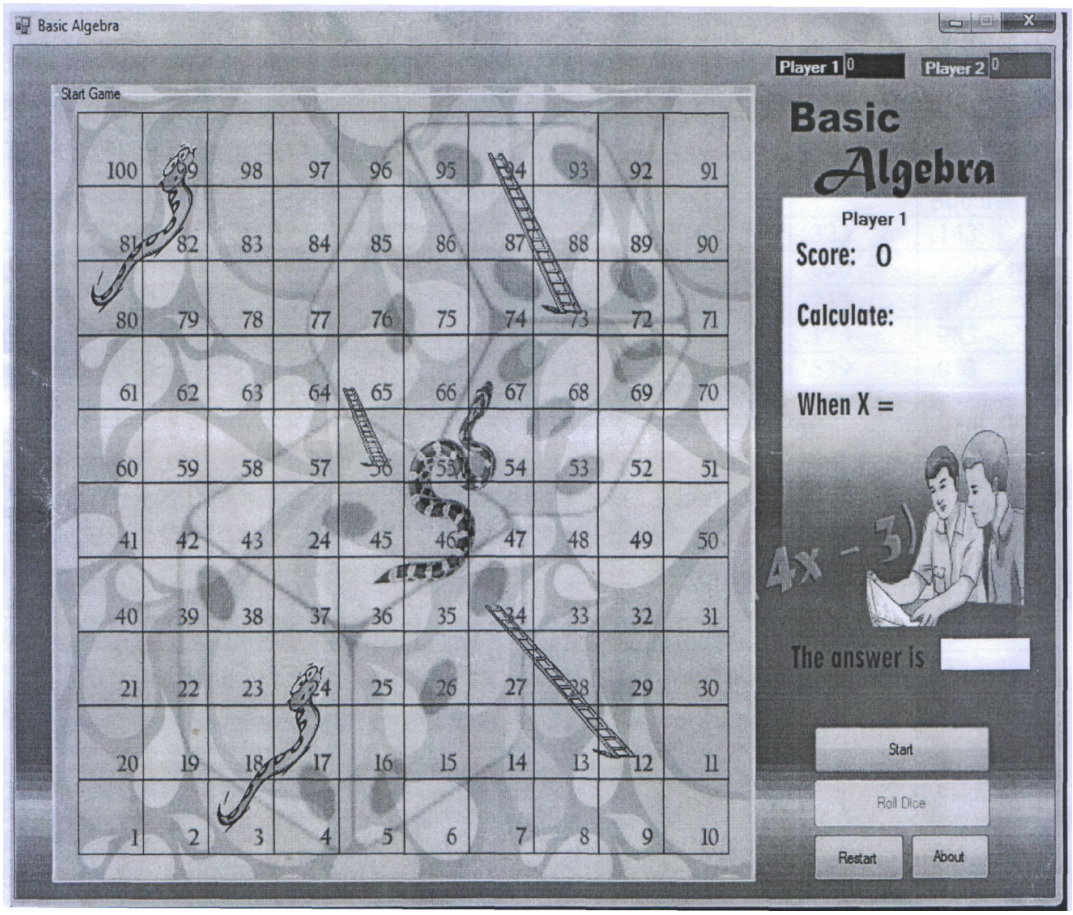

Figure 1: Sampled Compurised Mathematics Game

The Mathematics checklist was adapted from Junior Secondary School examination and validated copies were pilot tested on JS 3 students different from the location of the research. The data generated were subjected to cronbach alpha analysis and reliability coefficient of 0.70 was derived indicating that the instrument was reliable.

Mathematics interest checklist was designed and validated by experts in mathematics and test and measurement. The mathematics interest checklist has norm criterion that made it possible to detect some students who demonstrated trait of Mathematics Learning Difficulties (MLD). Mathematics achievement test adapted from junior secondary school terminal examination with reliability coefficient of 0.91.

The members of the experimental and control groups initially responded to a questionnaire instrument which included a Mathematics checklist. An Algebra test was also administered. During the pretest, the times spent by each of the participants were recorded as PRETIME. Thereafter, the experimental group was taught using algebra computer-based mathematics game while the control group was taught the same concept using the conventional method. Another set of questionnaires and tests were then administered again on the groups after six weeks of treatment. The times spent by each of the students on the tests were also

recorded as POSTTIM. Data collected were analysed using inferential statistics of Analysis of Covariance (ANCOVA) to test the hypotheses at .05 level of significance.

Results

The table below revealed the outcome of the analysis of data collected.

Table 1: Summary of analysis of covariance (ancova) of time spent by students on the post test

Source	Type III sum of squares	Df	Mean Square	F	Sig.	Partial Eta. Squares
Corrected model	925.150	3	308.383	29.992	.000	.786
Intercept	33972.246	1	33972.246	2973.501	.000	.993
Treatment	842.400	1	842.400	73.733	.000	.770
Gender	80.865	1	80.865	7.078	.014	.243
Treatment* gender	11.635	1	11.635	1.018	.324	.044
Error	251.350	22	11.425			
Total	39715.000	26				
Corrected Total	1176.500	25				

a. R Squared = .786 (Adjusted R Squared = .757)

Table 2: Scheffe post hoc multiple comparison of time spent

Treatment		Mean difference (I-J)	Std. Error	Sig.
(I) treatment	(J) treatment			
Control	Experimental	11.700*	1.363	.000
Experimental	Control	- 11.700*	1.363	.000

Table 3: Scheffe post hoc multiple comparison of gender

Gender		Mean Difference (I-J)	Std. Error	Sig.
(I) gender	(J) gender			
Male	Female	-3.625*	1.363	.014
Female	Male	3.625*	1.363	.014

Table 4: Summary of mean difference of time spent in the examination by the interaction of treatment and genders

			Post-Time	
	Gender	N	Mean	Standard Error
Control Group	Male	8	41.875	1.195
	Female	8	41.125	1.195
Experimental Group	Male	5	28.800	1.512
	Female	5	33.800	1.512

Hypothesis one states that there is no significant main effect of treatment on the time spent in Algebra examination by some identified Mathematics learning disabled students. The results of table 1 and 2 revealed a significant effect of treatment (mathematics game) on Time Spent in Algebra examination by some identified mathematics learning disabled student ($F(l,25) = 73.733$, $p < 0.05$). Since the p-value of the F ratio is significant, this means that hypothesis one was therefore rejected.

Hypothesis two states that there is no significant main effect of gender on the time spent in Algebra examination by some identified mathematics learning disable students. Tables 1 and 3 revealed that the main effect of gender on Time Spent in Algebra examination by some identified MLD students was statistically significant ($F_{(1,25)} = 7.078$, $p < 0.05$). Hence, hypothesis 2 was therefore rejected.

Hypothesis three states that there is no significant interaction effect of treatment and gender on the time spent in Algebra examination by some identified mathematics learning disabled students. The result from table 1 and 4 revealed that there was no significant interaction between treatment and gender on the time spent in the Algebra examination by some identified mathematics learning disable students. Since ($F_{(1,25)} = 1.018$, $p > 0.05$), hence hypothesis three was therefore accepted. Table 4 showed a higher mean time spent by male participants in the control group, but the trend is different for the experimental group.

Discussion

The study revealed significant effect of treatment (Computer Based Mathematics game) on time spent in Algebra examination by some identified Mathematics learning disabled student. The effect of computer based Mathematics game on time management or time spent in Algebra examination by participants might be attributed to motivation they derived from the digital game mode of instruction. The achievement of this instructional strategy could be seen as a welcome development in learning process of students in general. This development is line with the submission of Alavi, George and Yoo (2002) that said that information technology enhanced learning could be solution for promoting students' Mathematics learning motivation and achievement. The efficacy of computer-based Mathematics game on time management and achievement could be a new development. Time taken in every activities is always very crucial and adequate time management in instructional process is important.

Researches have revealed that most students, including low-achieving students, learn more when their lesson are conducted at a brisk pace because a reasonable fact pace serves to stimulate student attentiveness and participating (Wyne, Stuck, White and Coop, 1986). This is one of what digital based game learning stands to achieve in learning process of students especially students with mathematics learning difficulties.

The study also revealed that there is no significant main effect of gender on the time spent in algebra examination by some identified students with Mathematics learning disabled students. The result revealed main effect of gender on time spent in Algebraic examination by some mathematics learning disabled students. The results is in concordance with Levine, Susan, Huttenlocher, Janellen, Tailor, et al (1999) and Halpern (2000) who all reported that male outperformed their female counterpart in spatial activities/abilities. This can be attributed to innate inherent in males as they usually show great interest in computerised and manipulative activities whereas females demonstrate high dexterity in linguistic related activities. However, the study is contrary to the finding of Ajai and Imoko (2015) who reported no significant difference in the achievement of male and female participants

thereby given indication that male and female students are capable of competing in Mathematics both in mastery and time spent.

The study further revealed that there was no significant interaction between treatment and gender on the time spent in Algebraic examination by some identified Mathematics learning disabled students. This therefore means that there is no treatment implication on gender. The assumption is that the treatment has the same effect on male and female participants as regards time spent in Algebraic examination. This result is in line with the study carried out by Ajai and Imoko (2015) and Ritzhaupt, Higgins and Allred (2011) who reported no significant interaction of treatment and gender among their participants. It can then be concluded that the digital based Mathematics game learning has the effect on the participants not minding their gender affiliation.

Conclusion

Digital game based Mathematics instruction has added a new dimension to pedagogical innovation in the area of achievement, self-efficacy, motivation, interest and confidence among students especially those that demonstrated discrepancy in Mathematics contents mastery. This study was designed to test its effectiveness in improving time spend to achieve a level of mastery among students that show signs of Mathematics learning difficulties. The results have revealed the efficacy of computerised game based learning in improving time spent to solve sums in Algebra with no significant interaction between treatment and gender with implication that all the participants benefitted the same way.

Recommendations

In view of the results above, the following are recommended:

(i) Digital game based learning should be employed as pedagogical tool to teach Mathematics to students who show evidence partial and time constraints in Mathematics.

(ii) Gender equality should be encouraged in a very sensitive subject like Mathematics through computer game-based instructions because of its importance both academically and socially.

(iii) Efforts should be made to make students to be conscious of adequate pacing because the secret of human successes is dependent on effective time management.

References

Adebayo, F. A. (2015). Time management and students' academic performance in higher institutions Nigeria – A case study of Ekiti State. *International Research in Education*, 2(2), 1 - 11.

Ajai, J. J., & Imoko, I. I. (2015). Gender differences in Mathematics achievement and retention score: A case of problem-based learning method. *International Journal of Research in Education and Science*, 1(1), 45 - 50.

Alavi, M., George, M. M., & Yoo, Y. (2002). A comparative study of distributed learning environments on learning outcomes. *Information System Research*, 13(4), 404 - 415.

Brigitte, J. C., Claessens, J., Eerde, W. V., Rutte, C. G., & Roe, R. A. (2005). *A review of the time management literature*. Emerald Group Publishing Limited, 36(2), 66 - 80.

Brophy, J. (1986). *Teacher effects research and teacher quality*. Paper presented at the annual meeting of the American Educational Research Association. San Francisco April, 11th, 1980.

Chun-Ming, H., Iwen, H., & Gwo-Jen, H. (2014). Effects of digital game-based learning on students' self-efficacy, motivation, anxiety and achievements in learning Mathematics. *Journal of Computer Education,* 1(2-3), 151 - 166.

Fisher, C. W., Berlmer, D. C., Filby, N. N., Marliave, R., Cahen, L. S., & Disnaw, M. (1980). Teaching behaviour, academic learning time, and student achievement; An overview. In C. Denham & A. Lieberman (Eds.), *Time to learn,* Washington, DC U.S. Department of Education, National Institute of Education.

Garnett, K. (1998). Mathematics learning difficulties. *Journal of CEC.*

Halpern, D. F. (2000). *Sex difference in cognitive abilities.* N.J: Erlbaum Associate.

Kuo, M. J. (2007). *How does an online game based learning environment promote students' intrinsic motivation for learning natural science and how does it affect their learning outcomes?* 1st IEEE International Workshop on digital game and intelligent toy enhanced learning, Jhongli, Taiwan, March 26 - 28.

Louis, R. A., & Mistele, J. M. (2012). The difference in scores and self-efficacy by student gender in Mathematics and science. *International Journal of Science and Mathematics Education*, 10(5), 1163 - 1190.

Omolara, A. D. (2010). *Time management among the Nigerian undergraduates: A case study of University of Ado-Ekiti.* Unpublished B. Ed Dissertation, University of Ado-Ekiti.

Peters, M. L. (2013). Examining the relationship among classroom climate, self-efficacy and achievement in undergraduate mathematics. A multi-level analysis. *International Journal of Science and Mathematics Education*, 11(2), 459 - 480.

Sayan, H. (2015). The effects of computer games on the achievement of basic Mathematics skills. *Educational Research Review,* 10(22), 2846 - 2853.

Suan, J. S. (2014). *Factor affecting underachievement in Mathematics. Proceedings of the Global Summit on Educatio*n GSE 2014. Kuala Lampur, Malaysia 4th – 5th March, 2014.

Vasrullah, S., & Khan, M. S. (2015). The impact of time management on the students' academic achievement. *Journal of Literature, Language and Linguistics,* 11, 66 - 71.