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Developing an Interactive Multimedia System in Improving Teaching and Learning Processes in Basic Mathematics in Nigeria

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Abstract: Mathematics as a subject at all levels of educational pursuit has always been a nightmare to students. Different approaches to mitigating this by teachers in the past have not yielded the desire results. This research examines issues within the new frontier of integrating technology into mathematics education. It is an attempt to solving this problem by interactive multimedia system that incorporates game-based approach to motivate mathematics teaching and learning among Primary 6 pupils using Staff School, The Federal Polytechnic, Ado Ekiti, Nigeria as a case study. Two mathematics topics, the Lowest Common Multiple (LCM) and Highest Common Factor (HCF) in Primary 6 class were adopted in strict compliance with the curriculum of the Ministry of Education. The learning performance of using the developed system is compared with the traditional-based learning method in classroom. The correlation between the pupils' results from both tests for the pupils who took the two examinations is calculated and came out to be +0.29, showing that the computer-based group using interactive multimedia application significantly outperformed traditional group as measured by the test scores.
Keywords: Mathematics, Teaching and Learning, Interactive multimedia application, Lowest Common Multiple (LCM), Highest Common Factor (HCF)

I. INTRODUCTION

The technological applications, especially the use of multimedia applications have become more common in today's education, stimulating innovative approaches to teaching and learning. In recent years, research activities on the uses of computers and multimedia technologies in school have increased greatly. The difficulties in teaching and learning of mathematics as a subject are well-known. Interactive multimedia application provides a mechanism to revolutionize mathematics instruction. The use of new technologies facilitates both teachers and thestudents to effectively transmit the knowledge on mathematics. An increasing trend ofcomputer use at primary school level has caused changes in the learning process. Multimedialearning objects play vital roles as a supplement to theoretical teaching approach. Multimedia programs are designed to support and accelerate learning process. Educatorshave been using multimedia as teaching materials for years; this is because multimedia is ableto offer the experience of listening, looking and partaking in a computer-mediated setting. It canbe exciting, interesting, motivating, and helping students achieve understanding in new ways.The use of sound, pictures, animation and video enables the user to experience the real worldsituations which may not be possible with the conventional methods of instruction(Oliver, 2000). This means that computer and multimedia technologies have simply providedthe vehicle for teaching and learning.

Traditional and formal education may not have been able to engage students with differentstyles of learning. In any learning situation, students' feelings, attitudes and motivation tolearn are important to determine the learning performance on knowledge acquisition.

Traditional classroom teachers have been concerned about students' disengagement and lukewarm interest in studying mathematics as a subject. The design of a learning environment built on theeducationalproperties of games can be an appropriate way to improve learning. Digital games are user-centered; they can promote challenges, co-operation, engagement, and the development ofproblem-solving strategies. Prensky (2001) asserted that games have the power of engagingpeople. They are fun and provide interaction, interactivity, problem solving, story and otherelements that give the user involvement, structure, motivation and creativity, among otherbenefits. There were extensive empirical evidences supporting the positive effect ofeducational computer games used in enhancing students' performance in mathematics, science or military (McFarlane et al., 2002).

This paper discusses new approaches to teaching and learning mathematics at primary school level. It issuggested that using multimedia learning objects and computer aided learning can vastlyenhance effectiveness and positive impact of the mathematics learning process among younglearners.

This study seeks to design and develop amultimedia, interactive, mathematics video tutor with game-based learning application to teachtwo topics, Lowest Common Multiple (LCM) and Highest Common Factor (HCF)in Primary 6class of Staff School, The Federal Polytechnic, Ado Ekiti, Nigeria according to the curriculum of the Ministry of Education bycomparing the learning performance of using game-based e-learning with traditional-basedlearning in classroom.

II. RELATED WORKS

There are several papers that tried to evaluate the effect of using multimedia interactive tools onenhancing kids learning, particularly, in mathematical skills.

Haftamu et al, (2016) focuses on how the integration of multimedia based teaching approach into a Calculus and Numerical Methods module impact on student's performance and their attitudes toward educational technology.Empirical data was collected from controlled and experimental group students enrolled into mathematics module which include students' engagement using traditional and multimedia technology teaching and learning process. The result of their research indicates that the experimental group which is exposed to the multimedia based teaching and learning activities performs significantly than the controlled group which was taught using the traditional way of teaching.

Siew, (2009)describes an interactive multimedia web-based application aimed to foster apositive attitude among young learners toward mathematical science, using multimedia and game-based approaches. Their findings showed that there is a significant difference, (t = -3.881; df= 18; p < 0.01), between two tested groups, namely experimental group (mean$_1$ = 3.00±0.258) as compared to control group (mean$_2$ = 1.70±0.213).The result indicates thatcomputer-aided learning had an ability to advance the achievement of students in theirlearning subjects.

Setyaningrumand Waryanto, (2018) describe the development of interactive edutainment

Mathematics media for Junior High School, and todetermine the quality of the interactive edutainment media developed in regards to improvestudents' understanding and interest.The review suggested thatthe media was very good with the average score of 144.55 fromthe maximum score of 175.

Sawsan et al, (2012) investigate the impact of utilizing multimedia technologies on enhancing, or not, the effectivenessof teaching mathematical basic knowledgeand skillsin primary schools.Two groups are selected based on their own class distribution whereone group was taught the subject in basic math using a program developed for this purpose. Thesecond class was taught the same subject using traditional methods of teaching. Results showed that in such math skills at this age, usingprograms or multimedia enhanced methods of teaching can be effective in getting studentsattention especially when cartoon characters are used.

III. EDUTAINMENT-BASED LEARNING

In recent years, digital games have assumed an important place in the lives of children andadolescents. Children and young people are introduced to the virtual world via videogames,and the ways they interact with technology may be changing ways of learning and theproduction of knowledge. Engagement and motivation are interesting benefits of the use ofgames in learning.

The combination of education and entertainment is the current buzzword in e-learningcommunity. The well-known terms such as game-based learning, digital game-based learningor edutainment are popular phrases and all tapped as the teaching and learning technologiesusing the computer games. However, the value of computer games beyond entertainment isincreasingly taking into account. E-learning is moving beyond merely digital content foronline accessibility. Digital game-based learning is emerging as the new dynamic model of e-learning(Squire, 2005). Many reasons support toward game-based e-learning. The mostdirect reason is that people usually feel bored about traditional learning and e-learning, whilegames always can elicit motivation and provide the experience of engagement. Many peoplebelieve that educational games are effective because they motivate children to activelyengage in a learning activity as part of playing the game.

The use of educational games within lesson plans is an increasingly common practice for teachers and educational technologists. There are several pedagogical approaches that can beused inside and/or around a game, such as learning by doing, learning from mistakes, goal-orientedlearning, role playing and constructivist learning (Prensky, 2001).

Integrating computer assisted and game-based learning into the mathematics teaching and learning process can greatly enhance the learning experience and significantly increase success rate in knowledge acquisition for the majority of students.

Games connect specific content and skills with a userfriendly environment where the student is able to play, try, make mistakes and learn. At thesame time, game based e-learning approach may foster a positive attitude among younglearners toward mathematical science.

IV. SCREEN DESIGN FEATURE

The video interactive multimedia application was designed and implemented by integrating differentmultimedia elements. Special attention was given to the interactivity "user control", vivid colors, music and animations to make it more attractive anddifferent Than the traditional way.

Figure 1 Showing solution to LCM question

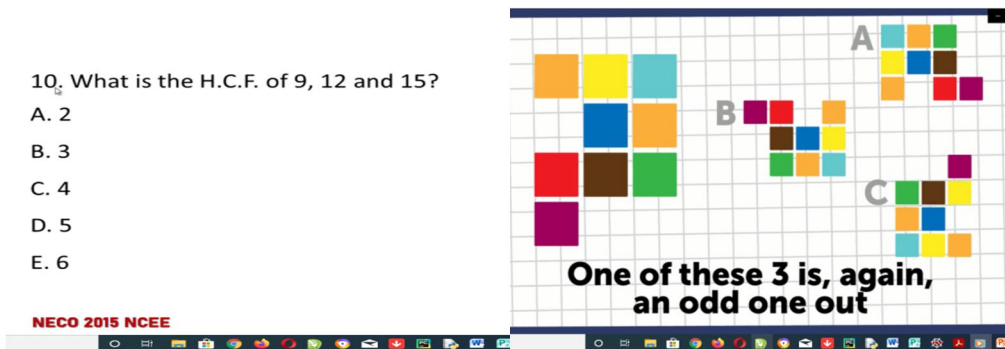Figure 2 showing solution to HCF question

Figure 3 showing multiple choice questions

Figure 4 showing mathematical riddles (games) for edutainment

V. METHODOLOGY AND CASE STUDY

The population of the study consists of all Primary 6 pupils of Staff School, The Federal Polytechnic, Ado Ekiti, Nigeria. The class is divided randomly into two groups. We designed and developed a video multimedia program that covered two topics – Lowest Common Multiple (LCM) and Highest Common Factor (HCF) from the class mathematicssyllabus according to the Ministry of Education curriculum and guidelines. Table 1 shows the researchprocedures adopted in this experiment.

	Study sample and activities	Traditional	Multimedia	Number of pupils/groups
Day 1	Topic 1: LCM	Group 1 60 pupils	Group 2 62 pupils	122
Day 2	Topic 2: HCF	Group 2 62 pupils	Group 1 61 pupils	123
		122	123	

Table 1: Experiment implementation procedure

As can be seen from Table 1, the research consists of two steps. In the first step, the first group wastaught by using traditional approach, whereas the second group was taught the same materials of thefirst group by using the newly developed video multimedia application. Each group was given a test. The firstwas subjected to a traditional text-based quiz, while the second group was given a computer-based test.In the second step of the research procedure, the two approaches were reversed.

VI.   METHODS AND PROCEDURES

In designing the application used in this research, the following procedures were utilized:

i. An interactive video multimedia program was built to cover two of the main topics (LCM and HCF) inmathematics for primary 6pupilsin line with the curriculum adopted by the Ministry ofEducation. This application was developed by using a combination of Camtasia Studio 7, Audacity and Microsoft Power Point as authoring tools.

ii. Different multimedia elements were used to deliver the needed information (text, colours, images, sound, and animation) with interactive and retroactive (feedback) features implemented within a user-friendlyinterface.

iii. At every 5 minutes intervals, the video interactive multimedia program presents a short mathematical riddles (games) to the pupils in form of entertainment to prevent the pupils from getting bored. At the end of this short mathematical riddles (games), the application gives the answer to the question that was presented to the pupils before proceeding to the next stage.

vi. The pupils were allowed to interact with the video interactive multimedia lesson for a maximum of 30minutes followed by a computerized short multiple choice tests. A traditional test is executed before using themultimedia program. Before both tests, students learn the basic mathematical skills through traditional methodsof teaching.

VII.   RESULTS AND ANALYSIS

In order to evaluate the impact of using video multimedia interactive educational tools in education, Primary 6 pupils ofStaff School, The Federal Polytechnic, Ado Ekiti, Nigeria were used as a case study.The class is divided into two groups; each group isfurther divided into another two groups. The same educational material which was about teaching basic mathematicalskills in LCM and HCF was taught through the traditional educational methods along with the multimedia interactive application.In order to reduce possible biases in the study, classes were selected as they are without anyrearrangement or reordering of the students in the 4 classes selected for the studies (two classes for eachmethod). At the end of the educational session, a simple mathematical multiple choice examinationwas conducted on the two teams.Table 2 shows the summary of the results for the average pupil grade (out of 10) in comparisonbetween multimedia and traditional exam. The correlation between the pupils' results from both testsfor the pupils who took the two examinations is calculated and came out to be +0.29.

	Multimedia	Traditional
Number of pupils	123	122
Mean	8.47	8.05
Standard Deviation	2.06	1.41

Table 2: Comparison of average scores between multimedia and traditional

As shown in Table 2, in the computer-based group using interactive multimedia application, the team significantlyoutperformed traditional group as measured by the test scores.

Paired Samples Test			
	N	Correlation	Sig
Text-based test & computer-based test	114	0.292	0.019

Table 3: Results after applying t-test

Results show a positive impact of using multimedia interactive tool for teaching mathematical skills in primary school.This is noticed through both averages of multimedia relative to traditional teaching.

VIII.   CONCLUSION

The work described here suggests that it is possible to develop interactive, multimedia application and games that are both entertaining and educationally useful. In this research, a multimedia, interactivemathematicsvideo tutor that teaches HCF and LCM incorporated withgames that have impact on students' interest and achievement in learningmathematicsis developed for students atyoung ages to evaluate the impact of interactive learning on students' abilities to improve their learningskills. In synchronization with several similar studies, results showed that those methods can beeffective especially for youngsters where they can be motivated by multimedia elements such as colours, sounds, graphics and animation.

As explained in the paper, and despite the fact that results showed improvements in students learningskills, however, this is not a proposal for replacement of traditional education. Rather, multimedia and interactiveenhanced learning can provide a very useful alternative for traditional education especially in caseswhere it is not applicable to teach through traditional methods.

IX.   ACKNOWLEDGMENT

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