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Advancement of the potentials of *Codices Video Game* for Senior Secondary School Mathematics learning in Kwara State

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Abstract

Teachers'inability to incorporate variety of instructional schemes has been reported in studies as major factors for the disappointing performance of students in Mathematics or science. This paper examined the development and usage of Codice Video Games (CVG) to teach and enhancestudents cognitive learning processes in Mathematics. The prospect of CVG to support learning and several researchers' efforts to assist learnersto overcome challenges related to mathematics were explored. A quasi-experimental-control group design was adopted. Four purposively selected senior secondary schools from the population with intact classes consisting of 50 SS II students were assigned to experimental and 60 others to control groups respectively in Irepodun local government area of Kwara State. The development and efficacy of a CVG on probability was conducted. A CVG rating scale whose reliability coefficient was determined through Kendall's concordance that yielded 0.76 index was used for data collection. Data obtained from the test scores of students were analysed, which revealed that students taught with CVG had higher

mean gain score than those taught with the conventional method in Probability, the interaction effect of CVG on gender favoured female than male students, CVG usage was loaded with potentials more effective for students' probability learning. Therefore, it was suggested that considerable attention should be given to the use of CVG in learning Mathematical concepts, and learner characteristics in Mathematics.

Keywords: Codice Video Game, Learning, Mathematics, Potential, Teaching.

Introduction

The teaching of Mathematics at all levels of Nigeria's education system might be characterized with situations that agitate public concerns. The persistent manifestation of pupils'anxiety throughout Mathematics class and tests has given rise to annual increase in the number of students failing the subject on a large scale (Musa, Mamudo, Mohammed & Audu, 2022). The country's growth and development would be hampered if this tendency persisted. This may be explained by the mathematics teachers' incapacity to employ teaching aids when imparting knowledge of the curriculum.

The use of instructional materials in mathematics teaching can benefit students and the subject matter more than expected. Using instructional resources to teach mathematics at all educational levels will inspire and pique students' interest in the subject from an early age. Nonetheless, the use of materials can significantly enhance all instruction, since they create a memorable learning environment and, when used wisely, encourage the most efficient type of learning.

In a similar vein, a large portion of the populace think that mathematics is magical and abstract. Teachers must use mathematics educational resources effectively and prepare themselves properly in order to dispel this myth. Mathematics Instructional Materials (MIM), which serve as an interface between educators, students, and instruction, are another name for the resource material utilized in mathematics classes.

Despite the fact that probability in Mathematics involves ideas like results, experiments, events, samples, space, possibilities, and Mutually exclusive events, these concepts can still be easily understood with the use of teaching resources. The chief examiners reports stated earlier however may compel one to assume that a large number of Mathematics teachers in the study area were not using teaching resources.Several studies have documented efforts to assist students in overcoming obstacles in mathematics, including the use of computer-based instruction (Wasike, 2013) and the Ludo game (Sam-Kayode & Salman, 2015). Studies in the literature on mathematics conducted with third-grade pupils and elementary school students have also shown some disparities in the impact of computer-based video games on students' performance. The Timez Attack Game (Muhammed, Zulqarnain, Ibrahim, Razol & Hilmi, 2012); the Fire Captain game (Chuang & Chen, 2009) on controlling fire burning an object and the safety precautions to take in an introductory technology; and the Game and Games flows experiences (Aremu & Adebagbo, 2016) on multiplication tables and fractions in Mathematics, respectively. Thus, the purpose of this paper was to explore the potential of Codice video game for Mathematics education in Nigerian classrooms.

Nonetheless, according to the National Policy on Education (FRN, 2018) and the curriculum specifications of the Upper Basic and Senior Secondary Education (JS 1-3 and SS 1-3), Mathematics is a fundamental and required subject in Nigeria. One of the primary goals for kids is to develop the comprehension and application of mathematical ideas and skills that are essential for success in the rapidly evolving technological environment. Prensky (2012), pointed out that teachers can use computer-based or digital game-based learning, such as video games like Codice, which embody the idea of a game specifically designed for educational use and used as an in-class teaching tool to facilitate achievement of curriculum objectives, in order to adapt their instruction to meet the needs of the students.

Sam-Kayode and Salman (2015) tested the efficacy of Ludo game on senior school students' performance in probability, which was similar to a dice game in that it involved the use of dice. In a similar vein, other games that are played with coins are called coins games. Although the dice and coins games have been proposed separately, there may be a chance to integrate them in order to improve a concurrently innovative application and believable achievement in mathematics. This rationale encouraged the combination of coins and dice into a word "Codice" to be applied in mathematics classroom instruction. As a result, the game that is played with coins and dice is known as a Codice game.

The two components of the Codice video game strategy application process are the instructional and the quiz/self-rated exercise sections. While the quiz or self-rated activity focuses on student performance in that subject and provides feedback on their learning outcomes, instruction focuses on teaching and learning probability.

Statement of the Problem

Mathematics is a core subject at the Senior Secondary School level due to its application in everyday human endevours. For this singular reason, Mathematics as a subject is required to be passed at credit level before a student could be admitted into any tertiary institution of higher learning in Nigeria. In spite of the efforts of researchers at ensuring some profitable results in the application of a variety of strategies and the implementation of their proposals for the enhancement of learners' performance in Mathematics, learners' recital in some aspects of Mathematics still remained worrisome. This apprehension sends signals that more efforts are still required to explore other opportunities to help learners overcome the problem. However, literature is devoid of reports predicted on involving Game-based video as instructional strategy to improve students' performance in Mathematics. This paper therefore examined the advancement of the potentials of Codice video

Game instructional strategy on senior secondary school students' performance in Mathematics.

Method

The study adopted a non-randomized, non- equivalent, control group, quasi-experimental design. The development of Codice video game and confirmation of its potential for Mathematics teaching was done in Irepodun Local Government of Kwara State in a second term of 2020/2021 academic session. An intact class of a Senior Secondary two (SS II) was purposively selected within the local government headquarter (basically for reliable power supply and availability of functional computer system) comprising 34 students for the efficacy of the game, while another comprising 39 students served as control.

Research Instrument

Two instruments were used in this study:Codice Video Game (CVG) and Mathematics Performance Test (MPT).

The Development and Description of Codice Video Game

Top-down design model (Rouse, 2014) was adopted as a technique suited to attain design, development and debugging of the Codice video game application. This model requires that a complex subject (goals) or large software programs can be constructed by decomposition of the code of the entire program into modules, that is, self-contained independent subprograms which has a well- defined interface to other related software components of the system. Hence, the programmer visualized and conceptualized the program structure, problem solving flow pattern and procedural requirements necessary for achieving the goals and the objectives of the project work.

Separate programs were written for each module (component/ subprogram) and put to work together by the researchers. A programmer in a tertiary institution in Nigeria provided an expertise to the use of programming language (www.coursera,org>articles>types)

like “Action script” with “classical java-style” class model was used as well as inclusive, “Swish Max” and “Adobe creative script” 6 (CS6). It is a flash, dynamic html and vector graphic tool that is commonly used to create interactive and cross-platform animations movies and presentation.

The Codice video game application design was first broken down into four subprograms: ‘tutorial,’ ‘codice instructions/rules’, ‘Codice self-rated exercise’ and ‘about us.’ The goal of achieving the tutorial and Codice self-rated exercise subprogram can be further broken down into tutorial pages (scenes) and self-rated exercises which constitute the core of the Codice Video Game. The tutorial pages/self-rated exercise scene is broken down into components resources required to implement the game: Graphics, text contents and animation effect. Furthermore, the main module interface features the navigation buttons. This allows users to move to the next and previous stages of the game. Main module hosts the menu buttons and background colour, alongside features special methods that executes navigation commands while manipulating both contents and objects animation.

In the same vein, tutorial interface hosts and displays lesson contents and appropriate animations to aid understanding. It also includes audio expression of lesson content which on its own facilitates comprehension of the topic. The Codice self-rated exercise section was designed to be an entertaining game instruction scene with both visual-audio characteristics and appropriate coin and dice related game exercise. Each game exercises share a module interface that displays the scores achievement of the player (user) and the number attempts made by the user. The goal of this interface is to measure students’ performance as they proceed in the game and animated graphics is for reinforcement purpose. Each question in the game is expected to be answered within 30 seconds.

The Mathematics Performance Test (MPT) validation was done by Mathematics Education Expert from the department of Science

Education, University of Ilorin, and experienced senior school Mathematics teachers and computer programmer experts. The reliability of the (MPT) was carried out through test and re-test method on 30 students selected outside the main study groups. The reliability index was 0.71. While, a draft of Codice Video game rating scale was made available to the Educational Technology expert from University of Ilorin and experienced senior secondary school Mathematics teachers to access the adaptability of the game to Mathematics classroom activities. Modifications were made and the adjusted package was trial tested on ten students from a different group equivalent to the sample. The computation of Kendall's coefficient of concordance yielded 0.53 reliability index.

Instructional part

The intact class of 34 students in the experimental group was trailed through the use of the Codice video game. They were guided on following the instruction which involves the interactive process of learning the probability topic. On the screen of the computer, from top left corner, there is a back to start (Menu). Also, from top right corner, there is a quiz and music. Bottom left corner of the computer, there is a previous menu and bottom right corner, there is the next menu. The probability topic has been prepared on slides/modules for presentation. Each slide/module involves the graphics and related animation object on probability.

Specimen Class

To play Codice Video Game

Step 1: turn on the computer; there are directories such as start, next and previous (Menu).

- Click on the tutorial (Menu) to show preamble stages of the game.

- Click on the next (Menu) to open a new slide/module.
- Click on the previous (Menu) to return to immediate past slide/module.

  Objectives: the students would first be exposed to the objectives. that is, what is expected of the students to achieved at the end of the lesson.
- Click on the next menu, to show another interactive/slide/module presentation. If eventually, the learner does not grasp the understanding of any topic (s) in each of the slide/module, the learner could.
- Click on previous menu to go back to the topic (s) to interact with it again until he or she master the topic or explanation of the topic (s) before proceeding to the next stage (s).
- Click on the next menu to continue the learning at your own pace and therefore, you can click on previous menu to go back and learn again.

Quiz/Self-rated Exercise Part

At any point, the presentation can be skipped in order to allow the player proceed to the quiz/self-rated exercise part. Students' self-rated aspect required students to follow the rules strictly.

Codice Video Game Instructions/Rules

- Answer each question within 30 seconds.
- Failure to answer the questions within 30 seconds makes you to lose 1 mark.
- Select the right answer by clicking the option buttons ranging from A to D ie A, B, C & D.

  Step 1:
- Click on the next (Menu) which shows four indicator boxes:

a. **Point:** shows the number of mark awarded to each correct answer.
b. **Total questions**: shows the number of questions in the game

c. **Questions failed**: shows the number of questions answered wrongly.
d. **Time left:** shows time for a question to be answered

- Click on the next menu which shows question number with four options, this is to be answered within 30 seconds. Each correct answer gives 1 point or mark and each wrong answer reduces the point or mark by 1.

  Note:

✓ If you fail to answer the question within the time frame, the computer automatically moves to the next question. If you answer the question within the time frame, you can click on the next menu. More so, you can as well go back to the previous menu to revise the slide/module presentation. This can be repeated several times, until you are satisfied.

- When you work within the time frame, and with the correct answer, you are likely to get good points or marks before the game is over. If otherwise, the point or mark to get will be very low before the game is over. This indicates that, you need to improve on the topic(s) on each of the slide/module presentation.
- By stepwise following the rules learners were made to work independently on the prepared module. The game was over when the learner exhausted the number of questions in the quiz/self-rated exercise part. Therefore, the learner could observe his or her total scores or points or marks at the top left of the screen.

It is important to state that the game can be played by an individual for multiplayer, there are two options:

1. The game can be hosted on internet for multiplayer, so that the player can subscribe monthly.
2. The game can be installed on each student's computer or laptop to play.

Specimen Result

The mean gain scores of Senior Secondary School two students in probability with and without Codice Video Game were obtained to ascertain the potential of the game in enhancing students' cognition in mathematics teaching and learning.

Table 1:*Mean Gain Scores of the Students in Probability with Strategies.*

Groups	Pretest	Post-test	Mean Gain Scores	Difference in Mean Gain Scores
Codice Video Game	44.00	65.06	21.06	***8.55***
Conventional Method	45.97	56.51	10.54	

Table 1 unveiled that the students mean score when taught with Codice video game was higher (65.06) than those taught with Conventional method (56.51) in probability. This shows that Students who used Codice video game on probability had a mean gain score of 21.06 while students taught Probability using the conventional method had a mean gain score of 10.54. Thus, the mean gain score of students taught with Codice video game was higher than those students taught with the conventional method in Probability by a mean score difference of 8.55.

We also determined the interaction effects of the Codice Video Game (CVG) and gender on the performance of senior secondary school two students in probability.

Table 2: Interaction Effect of Codice Video Game and Students Gender when taught Probability

Treatment	Gender	Mean	S.D.	Grand Mean	Mean Diff (I-J)
Codice Video Game (I)	Male	63.12	2.61	64.26	8.29
	Female	65.41	3.46		
Conventional (J)	Male	55.27	2.37	55.97	-8.29
	Female	56.66	2.74		

As shown in Table 2, male and female students taught with Codice Video Game performed ($\bar{x} = 64.26$) better than male and female taught probability without Codice video game ($\bar{x} = 55.97$). The interaction effect of the treatment (Codice video game) and gender was 8.29 and -8.29 for male and female taught with and without Codice video game respectively. It is further shown on the Table 2 that the interaction effect of CVG on gender favoured the female with higher mean (65.41) than the male (63.12) students.

The interaction effects of Codice Video Game and score level on the performance of senior secondary school two students in probability was equally tested.

Table 3: ***Interaction Effects of Treatment and Score Levels on Students Performance in Probability***

Treatment	Score Level	N	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	**Upper Bound**
Experimental Group	Low	13	63.054[a]	1.817	59.425	66.682
	Medium	15	65.849[a]	1.687	62.482	69.217
	High	6	65.409[a]	2.373	60.670	70.148
Control Group	Low	10	54.645[a]	2.081	50.490	58.801
	Medium	18	56.135[a]	1.584	52.973	59.297
	High	11	57.632[a]	2.186	53.268	61.997

a. Covariates appearing in the model are evaluated at the following values: pretest = 45.0548.

Table 3 shows the descriptive statistics of the interaction effect of the treatment and score level on students' performance in probability. As shown on Table 3, it could be observed that among students taught Probability using Codice video game, students of medium score level performed better ($\bar{x} = 65.85$) than the students of high level students ($\bar{x} = 65.41$), followed by the students of low score level ($\bar{x} = 63.05$) while students of low, medium and high score levels taught without Codice video game had the least mean scores ($\bar{x} = 54.65$, 56.14 and 57.63) respectively. All the results recorded from the sample show, that the Codice Video Game usage was loaded with potentials, which were more effective in comparison with the conventional method for students' probability learning.

Challenges to the Use of Codice Video Game Instructions

1. Playing a computer game is different from using an internet-browser, and that could cause a problem for some students.

2. A 40-minute class for developing complex higher – order thinking and a post-test within 24hours for measuring participants' outcomes may be inadequate.
3. The content of instructional treatments differs from one to another. That is, the possibility of designing a website that could perfectly match all contents within a computer game is likely impossible.
4. The small number of computers in a computer laboratory and the consent of students' parents

Remedies to the Challenges in using CVG

1. The user(s) should have attended computer lessons and their ability to use basic computer tools and internet-browsing resources would be a pre-requisite for participating.
2. How much time a student spends on the game or practice could be a major factor influencing children's motivation for learning and achievement. After all, human motivation is a function of human cognition involvement.
3. Different hypertext developed by different designers may result in different formats. To ensure that the design of the hypertext format and the content would be consistent with the game, the instrument's validity needs to be examined further.
4. There should be large number of computers in a computer laboratory to accommodate larger number of participants.

Conclusion

It is apparent that the use of Codice Video Game instructions is a new technology, which has not been widely spread in Nigeria's educational setting. However, it is a known fact, that the use of Codice Video Games can facilitate students' cognitive learning process. Having known this, Codice Video Games is a multifunction interactive media. And as such, children can still improve their cognition through playing computer and video games. Kids' play with computer games exemplifies forms of

knowing and being in the world that are irreducibly and simultaneously social, technical, material and symbolic.

Recommendations

1. In the use of Codice Video Game, attention must be given to guideline derived from game design and experimental methodology, as well as to learner characteristics and learning styles.
2. Future research should continue to investigate on the effect of Codice Video Games along with different instructional strategies on varied children's learning achievements, such as facts, concepts, comprehension, problem-solving or critical- thinking skills.
3. In the use future studies should consider human factors in a gaming environment, such as learners' individual differences, learning styles, preferences in learning visual or audio materials, and so forth.

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