



Effect of Computer Game-Based Instructional Strategy on Students' Learning Outcome in Mathematics

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The major objective of the study was to elicit the effect of computer game-based instructional strategy on senior secondary school students' learning outcomes in Mathematics. The researcher used a quasi-experimental pre-test, post-test, control group design to carry out the study. The treatment was computer game instructional Package and conventional teaching method. Two hundred and forty (240) second year senior secondary school students (SSSII) were randomly selected from six (6) public secondary schools in On do State Nigeria. The students' pre-test and post-test scores were subjected to Analysis of Covariance (ANCOVA), T-test and Chi-Square. The findings of the study showed that the performance of students exposed to computer game instructional package was better than their counterparts exposed to the conventional classroom instruction. Based on the research findings recommendations were made on the need to develop relevant computer game instructional packages for teaching Mathematics in Nigerian secondary schools.

Keywords: Computer game instructional packages; convectional teaching method; achievement in mathematics; attitude towards mathematics.

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1. INTRODUCTION

Mathematics occupies a unique position in the school curriculum. It is an integral part of life because it is needed by everyone for successful living. It is central to science related courses and is one of the important subjects taught in all schools throughout the world due to its relevance to other subjects most especially in the development of science and technology. Kolawole and Oluwatayo [1] maintain that in order to produce future scientists and technologists in quality and quantity, the knowledge of Mathematics is inevitable. Technological development is highly rooted in the study of Mathematics. Indeed, the evolution of Information and Communication Technology (ICT) derives a lot from Mathematics [2,3]. Technology has become a part of most of the activities in daily life.

The use of technology in schools is growing in both technological tools such as computer and related software. Moreover, the new technological tools related environment is growing in the general reform in Mathematics education to provide more enjoyable and effective learning opportunities to students. In recent years, much concentration has been focused on the improvement of Mathematics education with the help of technology. However, there is a lack of agreement on why and how technology should be incorporated into the educational programmes, what students should be taught and how to train educators to use technology Oyebanji [4].

For many years now, schools have been facing diverse learning problems including poor performance of students in Mathematics in various examinations. Many scholars Akinsola and Ogunlayo [5] have over the years carried out research on methods and ways of improving the teaching and learning of Mathematics at the primary, junior and senior secondary school levels. Despite these numerous researches, as well as efforts at the instructional level, the performances of students at both the West African Senior Secondary School Certification Examination (WASSCE) and National Examination Council (NECO) have not improved [6].

However, it was observed that poor performance in the Mathematics is caused by the poor quality of Mathematics teachers. Uwadia cited in Dahiru [7], views inadequate coverage of syllabus,

inadequate facilities for teaching, students' poor attitude to study, and heavy workload on teachers as causes of poor achievement in Mathematics. [8,9] found that the attitude of some teachers to their job is reflected in their poor attendance to lesson, lateness to school, unsavory comments about student's performance that could damage their ego, poor method of teaching and the likes affect students' academic performance in Mathematics. For a student to come out with good performance in Mathematics, it is expected that all aspects of the syllabus must be mastered.

The National Policy on Education (2004) shows that examination questions set by the two examination bodies in Nigeria (WAEC & NECO) cover the whole syllabus. Mathematics teachers in Nigerian schools still depend on traditional method of teaching Mathematics where the teacher works some examples on the chalk board while the students watch and later ask the students to copy the examples into their exercise books. The teacher thereafter gives similar problems to the students to solve. This approach does not allow for students' active participation in the teaching and learning process. At this period, it is obvious that there is a need for new innovation in technology that can enhance teaching and learning Mathematics in Nigeria.

Technological advances have provided the opportunity to create an entirely new learning environment in Mathematics by significantly increasing the range and sophistication of possible classroom activities. Access to technology provides teachers and students with tools which, when constructively used, can create opportunities for enhanced learning of Mathematics. One promising approach explored is the potential of computer games as tools for supporting Mathematics teaching and learning.

This study falls into the category of probability in mathematics. Probability deals with randomness. Basic concepts of probability as outcomes, events and sample space of random experiment are defined in the mathematics textbooks for the secondary school level. However, more emphasis is given on making interconnections between new ideas and students' previous knowledge of elementary set theory. For this reason all concepts such as inclusion, intersection, union and difference of events are illustrated on several types of Venn diagrams. Exercises to practical construction of a sample space and events related to the experiment are

also included. The students of today like working with computers and enjoy using nontraditional and modern teaching methods. If properly supervised and guided, they can understand important basic principles of the probability through the trial and error method and, at the same moment, try to guess the results of given problems and verify them by computer simulation.

2. LITERATURE REVIEW

2.1 Academic Performance and Computer Games

Computer game often offers the learner an opportunity to use skills that are not rewarded in the usual classroom situation. Such skills might include creative ideas, social interaction or strategy. Computer games can also be used to make students interact with each other, learn from each other, develop co-operation skills, build self confidence and self-worth in students who are not academically skilled, since in playing the games, they use their own personal skills in winning.

Computer games have been found to be effective in motivating students learning performance [10,11].

Papasergiou [12] asserts that incorporating computer games within education provides a valuable link between activities within the classroom and life outside school. Such a connection will help to reinforce learning and may encourage students to continue to develop their ICT skill outside the classroom environment. Dickey [13] says that interactive learning environment allows learner to construct understandings by interacting with information tools, and materials as well as by collaborating with other learner within the game.

Games are seductive, deploying rich visual and spatial aesthetics that draw players into fantasy world that seem very real in their own terms, exciting awe and pleasure [14]. To put it simply, games are engaging. They motivate students using entertainment, and this is a part of the natural learning process in human development [15].

Leigh [16] in his study discusses the idea that games promote cognitive and problem-solving skills. The study states that most children are "masters of the game. Young children can sit at a

computer for hours playing computer games" [16]. Therefore, since children like playing game, teachers should create computer Mathematics game so that students may practice computation on the computer. The computer games should include learning strategies to increase students' comprehension. These games should reinforce learning, provide immediate feedback, and improve test-taking skills. The computer Mathematics practice can also be used to replace drill work. Computer games can be constructed to meet the curriculum objective.

Roschelle et al. [17] support the use of computer game-base mathematics education in the classroom. Their finding indicates that computer technology can help support learning, and that it is especially useful in developing the higher-order skills of critical thinking, analysis, and scientific inquiry. This article explores the various ways computer technology can be used to improve how and what learner learn in the classroom by helping students understand core concepts in Mathematics, science and literacy. These authors agree that computer-based Mathematics builds confidences and is a great tool for remediating slower learners.

In a more personalized study, Don Hernandez [18] uses mixed methods to research game play as a tool to motivate "at-risk" seventh and eighth grade students in his middle school to learn and build self-efficacy. In 2007, educational games were introduced to students during one of their Mathematics lab classes. They were taken through the game and given time to learn the modalities and objectives before the end of the lab, then students were given the option to join an after school gaming session. Due to increased interest, a morning session was opened as well. From the 2007-2008 to the 2008-2009 school years, the school's Mathematics proficiency standards on the Texas Assessment of Knowledge and Skills (TAKS) increased from 63% to 80% students passing at or above grade level.

In contrast, Kebritchi et al. [19] collect information on sixteen empirical studies where games were used as a learning tool. Four of these studies were conducted on a secondary school level and considered motivation as a dependent variable. From these four studies, two used a qualitative research method, one used a quantitative, and the final study used experimental and mixed methods. The four studies show positive results in increased student motivation in the classroom.

Both teachers and students reported that the Maths games, used as a learning tool, presented a slightly higher and very positive effect on class motivation.

Beverly Ray and Gail A. Coulter [20] emphasize the necessity of presenting, supporting and integrating the game as a class activity. Caftori [20] indicates that educational games have minimal significance without the support of knowledgeable teachers. Scaffolding must be used to ensure that connections are being made between the game and the curriculum being presented to the students.

Oblinger [21] and Gee [22] agree that a game would turn out to be good for learning when it is built to incorporate learning principles. Some researchers have also supported the potential of games for affective domains of learning and fostering a positive attitude towards learning [23,10,24]. They suggest that the use of educational games is an effective means of improving students' attitudes towards Mathematics.

Study conducted on 1,274 1st- and 2nd-graders, Rosas et al. [25] found a positive effect of educational games on the motivation of students. Although there is overall support for the idea that games have a positive effect on affective aspects of learning, there have been mixed research results regarding the role of games in promoting cognitive gains and academic achievement.

In the meta-analysis, Vogel et al. [24] examined 32 empirical studies and concluded that the inclusion of games for students' learning resulted in significantly higher cognitive gains compared with traditional teaching methods without games. It has been shown that educational games attract and gain students' attention, contributing to their increased motivation and engagement with mathematics [26] Young-Loveridge 2005; [10].

The direct relationship between improving the quality of teaching and improving students' learning in mathematics is a common trend emerging from educational research [27]. It is what a teacher knows and can do that influences how he or she organizes and conducts lessons, and it is the nature of these lessons that ultimately determines what students learn and how. Educational games' successful deployment in mathematics classrooms is highly dependent upon the knowledge, attitudes, and experiences of teachers with respect to games. Thus, the

provision of high quality teacher professional development on the educational applications of games is of paramount importance to their effective integration in classroom settings. From the views of scholars above, one could conclude that computer game promote self-learning since they enrich learner imagination and expands his/her experiences, and more effective than traditional method in gaining the interest of learner and motivating learner to become more involved in their learning activities.

2.2 Purpose of the Study

The study investigated the effect of computer game-based instructional strategy on the performance of secondary school students in Mathematics. By emphasizing the use of computer game to teach mathematics, it is hoped that the study will lead to the improvement of mathematics teaching and learning in our secondary schools. The general poor performance of students in mathematics and their attitudes towards some aspects of the subject are expected to be better. With this study, the researcher aims at exposing the teachers and students to the importance of using computer game to improve the teaching and learning of mathematics.

2.3 Research Hypotheses

Based on the stated problem, this study will test the following null hypotheses at 0.05 level of significance.

H₀₁: There will be no significant main effect of computer game instructional strategy on students' achievement in Mathematics.

H₀₂: There will be no significant main effect of computer game instructional strategy on students' attitude towards Mathematics.

3. RESEARCH METHODOLOGY

3.1 Research Design

A pre-test, post-test control group quasi-experimental design Campbell and Stanley [28] was adopted for this study. The design is suitable for this study as it enables the researcher to determine the effects of treatments on the dependent variables- students' achievement in Mathematics, students' attitude towards Mathematics. This paradigm represents two levels of treatment: the Computer Game-based

(experimental group), and the Conventional Teaching method (control group)

3.2 Sample

The target population for this research was the second year senior secondary Mathematics students in on do State. Judgmental sampling procedure was used to select two hundred forty students (240) in six Public Secondary Schools in the State that were used for the study based on the under-listed criteria;

- (i) They have presented candidates for Senior Secondary School Certificate Examination for at least ten consecutive years;
- (ii) they have qualified Mathematics teachers with at least one of them handling Senior Secondary School II;
- (iii) they have at least 30 to 50 working computer systems and access to internet facility and
- (iv) They have at least one (1) generator, in case there is power failure.

3.3 Research Instruments

The instruments used for this study are three:

- (i) Mathematics Achievement Test (MAT)
- (ii) Mathematics Students Attitudes Test (MSAT)
- (iii) Computer Game instructional Package (CGIP).

The MAT instrument contained fifty structural multiple-choice questions with five options each which were drawn from the past West African Examination Council (WAEC) Mathematics paper II questions while the MSAT was based on a four-point scale. These are Strongly Agree (SA), Agreed (A), Disagree (D) and strongly Disagree (SD) (See Appendix).

3.4 Computer Game instructional Package (CGIP)

The package comprises of three levels which are: the beginner, the intermediate and the advance level. The topic covered in the package is probability. The player is expected to have read and understand the instructions and the tutorial on probability before the start of the game. For every correct answer, the player gains 20 points, and also for every wrong answer 5 points will be subtracted from players' points.

The package was developed by the researcher with the assistance of a professional programme developer using Dream Weaver and Flash, written in Hypertext Markup Language (HTML) with illustrations converted to Graphic Interchange Format (GIF). Intrinsic programming sequence in which single alternative frame exists to reinforce concepts that appear difficult to some students was adopted. Validation involved the evaluation by Mathematics experts for the appearance, operation and logic of hyperlink, spelling, grammar, readability, and clarity from the viewpoint of persons unfamiliar with the content. In addition, end users' usability evaluation was done through a pilot study on a sample, similar to the final sample used in the study. The results obtained in the usability experience were used for improvement of the package.

3.5 Validation and Reliability of Instruments

The two instruments (MAT and MSAT) were given to experts in the field of Educational Technology, Mathematics educators in the Department, to vet the structuring, adequacy, content validity as well as task level of the items.

3.6 Pilot Study

A pilot study which lasted three weeks was arranged before the main study with the following objectives:

1. To further validate the instruments to be used in the study and, more importantly, to serve as another try-out stage for the computer game, this will enable the researcher to ascertain the time to be allocated per session of the game.
2. To trial-run the whole study with the aim of identifying flaws and problem area in the design to enable the isolation of design weaknesses and apply necessary corrective measures before the commencement of the main study.
3. To test the hypotheses formulated for the study based on data from a smaller sample identical to the selected for main stud.

3.6.1 Results of the pilot study

The scores of students in the pilot were analyzed in Table 1, using parametric statistics of independent t-test Statistics.

3.7 Procedure for Data Collection

All the groups (experimental and control groups) were subjected to the MAT as pre-test. Then, the students in experimental group were exposed to CGIP which had been installed on desktop computers using a web browser (Explorer), with two students working on a desktop computer. Other applications such as Internet access, CAI packages, games, and so on were disabled or removed. The students in the experimental groups were introduced to the Computer game instructional package format under teacher's supervision long enough for them to be familiar with the navigation buttons and use the package independently. In addition, they were encouraged to take enough notes that could be useful for them in the post-test. The control group students were exposed to the conventional teaching method on the same content used for experimental groups. They were taught using conventional classroom format.

4. RESULTS

The scores of students in the groups were analyzed using ANCOVA, T-test and Chi-Square. The analysis was done using the two research hypotheses stated for the study. The results of

the analyses and discussions are as stated below.

4.1 Hypothesis One

There will be no significant main effect of computer game-based instructional Strategy on student's achievement in Mathematics.

Table 2 shows that an $F(2,117) = 36.920$, $\alpha = 0.000$ for the main effect (treatment) was significant. This is because the significance of $F = 0.000$ is less than the 0.05 alpha level. There was a significant difference on student's achievement in mathematics on class tests within the period of the study. Thus, hypothesis 1 is rejected. The reason for this may be due to the fact that the student in the experimental group has been exposed to the use of simulation game instead of the conventional teaching method has been used.

The result in Table 3 also confirms that significant difference on class-test achievement scores between the two groups, showing that the students in the computer game-based perform better than their counterpart in the control group because, the calculated t-value is 13.704 while the table value is 1.96. Since the calculated t-value is greater than the table value, thus null hypothesis 1 is rejected.

Table 1. Parametric statistics of independent t-test statistics

Treatment	Mean	N	Std. Deviation	Std. Error Mean	t-cal	t-val	Df	Sig. 2-tailed
Experimental	17.49	30	3.37	0.34	8.704	1.96	58	000*
Control	12.42	30	2.95	0.22				

* = significant at $p < 0.05$

Table 2. Analysis of covariance for the class – tests achievement scores between experimental and control group

Source of variation	Sum of squares	df	Mean squares	F	Significance of F
Covariates (Pre-test)	981.571	1	981.571	433.589	.000
Main effect (treatment)	167.160	2	83.580	36.920	.000
Explained	1148.731	3	382.910		
Residual	262.604	116	2.264		
Total	197.465	119	11.8599		

* denotes F is significant at 0.05 alpha level

Table 3. T-test on class-test achievement scores between the two groups

Treatment	Mean	N	Std. Deviation	Std. Error Mean	t-cal	t-val	df	Sig. 2-tailed
Experimental	27.49167	120	4.36948131	0.39887725	13.704	1.96	238	000*
Control	21.41667	120	2.952234	0.269501				

* = significant at $p < 0.05$

4.2 Hypothesis Two

There will be no significant main effect of computer game-based instructional strategy on attitude of students' towards Mathematics

Table 4: Show the Chi-Square of pre- attitude scores between the experimental and control groups. The result shows that the students' attitudes before the commencement of the treatment are not significant difference. Because, the calculated value 26.1 is less than table value of 36.41.

Table 5: Show the Chi-Square of post- attitude scores and it indicates that there is significant difference in the attitude of students towards mathematics at the end of the treatment. The hypothesis 2 is rejected. On examination of the mean post attitude scores, it was discovered that calculated value 38.22 is greater than table value of 24.31. This implies that the computer game-based groups has a better attitude development than control groups.

5. DISCUSSION

The findings from the study have shown that computer game-based instructional package is an important method of teaching which affects students' achievement in and attitude towards mathematics. The use of the selected game in the context of an appropriate educational design facilitated the achievement of general educational objectives and is equally effective with the non-gaming approach in terms of achieving standard curriculum Mathematics educational objectives. The fact that there are research findings showing that educational games can be as effective as non-gaming approaches, with regard to the achievement of Mathematics related objectives, [25,10] allows us to infer that not only specially-designed educational games but also general-purpose commercial games can contribute to the achievement of standard curriculum Mathematics educational objectives when used as part of appropriately designed activities.

In hypothesis 1, there was no significant difference in achievement between the students in the control and in the experimental groups at the initial stage, that is, at the pre-test level. But at the post-test level, there was a significant difference in achievement between the students in the control and in the experimental groups.

Computer games were used to teach the students in the experimental group, while conventional method was for the control group. This result is in consonance with the finding of Aremu [6], Udousoro [29] in Mathematics and the findings of Jegede et al. [30] which are directly on biology. The result is also similar to the studies by Egunjobi [31] in geography, Okoro and Etukudo [32] in chemistry, conducted in Nigeria which confirmed that Computer game has been effective in enhancing students' performance in other subjects than the conventional classroom instruction.

Table 4. Chi-square table for per-test attitude between experimental and control groups

Df	24
Significant level	0.5
Table value X^2 value	36.41
Calculated X^2 value	26.1

* denotes F is not significant at 0.05 alpha level

Table 5. Chi-square table for post-test attitude between experimental and control groups

Df	24
Significant level	0.5
Table value X^2 value	24.31
Calculated X^2 value	38.22

It could be observed that in hypothesis 2 there is also significant difference in the attitude of students between the experimental and the control groups at the post-test level. These findings agree with the earlier finding of Akinsola and Animashun [33], Adebago [34], Ruffin [35], and Value and Leder [36] on attitude of student's toward Mathematics. The result of this study has shown that the teacher's role is not simply that of a facilitators whose task is to provide a suitable environment in which students are presented with new opportunities for learning, but his task includes encouraging students' motivation so that their academic performance could be improved.

The National policy on education (2004) stipulated that no educational system can rise above the quality of its teacher. Teachers' attitude towards teaching and learning of Mathematics has a significant impact in shaping the attitude of students towards learning of Mathematics. Students' positive attitude can be enhanced by the teacher positive attitude towards teaching of Mathematics and this can be done through teachers' helpful behaviour, resourcefulness, enthusiasms, good method of

presentation, concern for students and teacher knowledge of the subject matter.

The outcome of this study also indicates that students' attitude is positively affected by the use of computer game-based. The data collected in this research confirm that student' poor academic achievements are partly due to the method of teaching used in teaching them. Most of the teachers teaching in schools were not even ready to diversify their teaching methods and this will not help teaching / learning situations.

In the light of the finding from the data that the students have difficulties in learning Mathematics and that only the traditional method of teaching is in vogue in schools, this study contends that the situation needs to be changed. Mathematics teachers in the secondary schools should channel students towards positive attainable goals in learning Mathematics by reducing their difficulties and making the teaching and learning of Mathematics practical and meaningful through the use of computer game-based and other activities based strategies.

6. CONCLUSION

There is need to re-emphasize the effectiveness of computer games for the teaching of Mathematics concept as the computer instructional game used in this study led to significant improvement in teaching probability concept in Mathematics. Furthermore, the fact is also established that attitude may not be constant due to emotions and changing prevailing circumstances. Attitude can only be measured over reasonable long period of time to observe any change towards Mathematics.

Social interaction is one of the most important goals in a Mathematics classroom. A Mathematics classroom should provide opportunity for classroom interaction that promotes intellectual sharing and value different ways of solving problems. The teacher should objectively guide and facilitate these interactions to make learners see, hear and feel Mathematics, feel safe and willing to take risks, learn mathematics through doing and talking about it, be active and enthusiastic about learning Mathematics made easy through computer games.

Again, it must be realized that these computer games like any other game should be incorporated into the Mathematics curriculum as

one of the many teaching strategies which can be a very effective part of the present Mathematics curriculum.

7. RECOMMENDATIONS

It is recommended that teachers should regularly develop positive attitude towards the teaching of Mathematics since they are the role models. The responsibility of the Mathematics teacher ends when he has taught his students to understand the concepts and how to apply them in a variety of ways in solve daily mathematical problems. Finally, seminars/workshops on positive teachers' disposition and the use of computer game-based while teaching should be addressed by all education stakeholders as important and urgent.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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APPENDIX 1

**CENTRE FOR EDUCATIONAL TECHNOLOGY
TEACHER EDUCATION DEPARTMENT
UNIVERSITY OF IBADAN, NIGERIA.
Mathematics Achievement Test (MAT)**

Class: SS II

Time Allowed: 1 ½ Hours

Instructions:

- (a) Attempt all the questions. All question carry equal marks.
 - (b) Mathematics table or calculator may be used in any question
 - (c) Each question is followed by five options lettered A to E. Find out the correct option for each question. Give only one answer to each question.
1. A number is chosen at random from the set {1, 2, 3, - - - 9, 10}. What is the probability that the number is greater than or equal to 7? (a) $\frac{1}{10}$ (b) $\frac{3}{10}$ (c) $\frac{2}{5}$ (d) $\frac{3}{5}$ (e) $\frac{7}{10}$
 2. A fair die is rolled once. What is the probability of obtaining 4 or 6? (a) $\frac{1}{12}$ (b) $\frac{1}{6}$ (c) $\frac{1}{3}$ (d) $\frac{1}{2}$ (e) $\frac{2}{3}$
 3. Three balls are drawn one after the other with replacement, from a bag containing 5 red, 9 white and 4 blue identical balls. What is the probability that they are one red, one white and one blue? (a) $\frac{5}{102}$ (b) $\frac{5}{136}$ (c) $\frac{5}{162}$ (d) $\frac{5}{204}$ (e) $\frac{5}{243}$
 4. The balls are chosen with replacement, what is the probability that both of them are white? (a) $\frac{1}{7}$ (b) $\frac{2}{91}$ (c) $\frac{1}{49}$ (d) $\frac{1}{91}$ (e) $\frac{1}{98}$

Read this question and answer questions 5 and 6. If a die is tossed twice, what is the probability for it to?

5. Show a sum of 8 points? (a) $\frac{5}{36}$ (b) $\frac{5}{26}$ (c) $\frac{5}{20}$ (d) $\frac{5}{28}$ (e) $\frac{5}{40}$
6. Show a sum of 11 points? (a) $\frac{1}{18}$ (b) $\frac{2}{17}$ (c) $\frac{1}{36}$ (d) $\frac{2}{25}$ (e) $\frac{1}{25}$

Use the information to answer questions 7, 8, and 9. Three coins are tossed once. What is the probability of getting?

7. 3 heads? (a) $\frac{1}{10}$ (b) $\frac{1}{8}$ (c) $\frac{2}{9}$ (d) $\frac{3}{8}$ (e) $\frac{5}{8}$
8. 2 heads and a tail? (a) $\frac{2}{9}$ (b) $\frac{3}{8}$ (c) $\frac{1}{8}$ (d) $\frac{1}{10}$ (e) $\frac{5}{8}$
9. No head? (a) $\frac{2}{9}$ (b) $\frac{1}{10}$ (c) $\frac{1}{8}$ (d) $\frac{5}{8}$ (e) $\frac{3}{8}$

Use the information to answer questions 10, 11 and 12. From a deck of 52 well shuffled cards, a card is picked at random. What is the probability it is

10. An Ace of clubs? (a) $\frac{3}{52}$ (b) $\frac{1}{26}$ (c) $\frac{1}{52}$ (d) $\frac{1}{13}$ (e) $\frac{2}{13}$
11. A king of diamonds? (a) $\frac{1}{52}$ (b) $\frac{3}{52}$ (c) $\frac{1}{26}$ (d) $\frac{1}{13}$ (e) $\frac{2}{13}$
12. A Jack of spades? (a) $\frac{1}{26}$ (b) $\frac{1}{52}$ (c) $\frac{3}{52}$ (d) $\frac{2}{13}$ (e) $\frac{1}{13}$

Use the information to answer questions 13, 14 and 15. A fair octahedral (eight-sided) die has the following numbers on its faces: 2, 3, 1, 2, 1, 3, 1,1. Each time the die is thrown, the score is the number on the top face. If the die is thrown.

13. Once, what is the probability that the score is not 3? (a) $\frac{3}{4}$ (b) $\frac{1}{4}$ (c) $\frac{3}{8}$ (d) $\frac{1}{2}$ (e) $\frac{1}{8}$
14. Twice, find the probability of scoring a total of 6 (a) $\frac{3}{8}$ (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) $\frac{1}{8}$ (e) $\frac{3}{4}$
15. Twice, find the probability of scoring a total of 5 (a) $\frac{9}{16}$ (b) $\frac{1}{4}$ (c) $\frac{3}{8}$ (d) $\frac{1}{2}$ (e) $\frac{3}{4}$
16. The probability that Ade and Olu pass an examination is $\frac{3}{4}$ and $\frac{3}{5}$ respectively. Find the probability of both boys failing the examination (a) $\frac{1}{10}$ (b) $\frac{3}{10}$ (c) $\frac{9}{20}$ (d) $\frac{6}{20}$
17. Find the probability that the sum 8 appears in a single tossed of a fair dice (a) $\frac{1}{12}$ (b) $\frac{1}{8}$ (c) $\frac{5}{36}$ (d) $\frac{2}{9}$ (d) $\frac{2}{3}$

18. 51 women wore colored shoes to a party, out of which 21 wore purple and 9 wore white. If a woman is selected at random, what is the probability that she is wearing neither a purple shoe nor a white shoe? (a) $\frac{10}{17}$ (b) $\frac{7}{17}$ (c) $\frac{20}{51}$ (d) $\frac{3}{17}$ (e) $\frac{1}{51}$
19. A die with faces number 1 to 6 is rolled once. What is the probability of obtaining 3 or 4? (a) $\frac{1}{36}$ (b) $\frac{1}{6}$ (c) $\frac{1}{3}$ (d) $\frac{1}{2}$ (e) $\frac{2}{3}$
20. Two fair dice are tossed together. Find the probability that the total score is at most 4 (a) $\frac{1}{12}$ (b) $\frac{1}{9}$ (c) $\frac{5}{36}$ (d) $\frac{1}{6}$ (e) $\frac{1}{3}$

Use the information to answer question 21, 22, 23 and 24. A pack of 52 playing cards is shuffled. One card is picked at random, noted and replaced. The pack is shuffled and a card is picked at random again. What is the probability of getting?

21. Two nines (a) $\frac{1}{169}$ (b) $\frac{1}{52}$ (c) $\frac{3}{52}$ (d) $\frac{1}{26}$ (e) $\frac{1}{3}$
22. An ace first and a spade next (a) $\frac{1}{26}$ (b) $\frac{1}{52}$ (c) $\frac{1}{13}$ (d) $\frac{3}{13}$ (e) $\frac{3}{52}$
23. A black card and a red card in any order (a) $\frac{1}{26}$ (b) $\frac{1}{52}$ (c) $\frac{1}{2}$ (d) $\frac{1}{13}$ (e) $\frac{3}{13}$
24. An ace and a spade in any order? (a) $\frac{1}{13}$ (b) $\frac{2}{13}$ (c) $\frac{3}{13}$ (d) $\frac{1}{26}$ (e) $\frac{3}{52}$
25. A die is thrown and a coin is tossed. What is the probability of getting a 1 and a head together? (a) $\frac{1}{12}$ (b) $\frac{1}{6}$ (c) $\frac{1}{3}$ (d) $\frac{1}{2}$ (e) $\frac{2}{3}$
26. A fair coin is tossed once. What is the probability of getting a head or a tail? (a) 0 (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) 1 (e) 2

Use the information to answer question 27, 28, 29 and 30. A bowl contains three oranges and two mangoes, a boy pick a piece of fruit at random and eat it. A little later a girl picks a piece of fruit at random from those remaining and eats it. What is the probability that the following pieces of fruit are left in the bowl.

27. One orange and two mangoes (a) $\frac{3}{10}$ (b) $\frac{3}{5}$ (c) $\frac{1}{5}$ (d) $\frac{1}{10}$ (e) $\frac{4}{5}$
28. Two oranges and one mango (a) $\frac{3}{10}$ (b) $\frac{5}{10}$ (c) $\frac{4}{5}$ (d) $\frac{1}{10}$ (e) $\frac{1}{5}$
29. Three orange (a) $\frac{3}{10}$ (b) $\frac{3}{5}$ (c) $\frac{1}{10}$ (d) $\frac{1}{5}$ (e) $\frac{4}{5}$
30. Three mangoes (a) $\frac{3}{10}$ (b) $\frac{3}{5}$ (c) $\frac{1}{10}$ (d) $\frac{1}{5}$ (e) 0

Use the information to answer question 31 and 32. A letter is chosen from the alphabet at random. What is the probability that it is contained in the word?

31. IKEJA (a) $\frac{5}{26}$ (b) $\frac{3}{26}$ (c) $\frac{2}{23}$ (d) $\frac{1}{13}$ (e) $\frac{2}{13}$
32. APAPA (a) $\frac{5}{26}$ (b) $\frac{3}{36}$ (c) $\frac{2}{13}$ (d) $\frac{1}{13}$ (e) $\frac{2}{23}$
33. 48% of students in a school are girls. A student is picked at random what is the probability that a boy is picked? (a) $\frac{13}{25}$ (b) $\frac{2}{13}$ (c) $\frac{1}{13}$ (d) $\frac{2}{23}$ (e) $\frac{3}{25}$

A coin is tossed three times. Find the probability of obtaining **(Use the information to answer question 34 and 35)**

34. At least one tail (a) $\frac{7}{8}$ (b) $\frac{3}{8}$ (c) $\frac{1}{4}$ (d) $\frac{2}{7}$ (e) $\frac{1}{7}$
35. Two heads (a) $\frac{3}{8}$ (b) $\frac{1}{4}$ (c) $\frac{2}{7}$ (d) $\frac{3}{16}$ (e) $\frac{1}{8}$

A class of students was given a spelling test. The numbers of errors they made are given in table.

Number of Errors	0	1	2	3	4	5
Frequency	8	7	10	7	5	3

Use the table to answer question 36, 37, 38 and 39

36. How many students are in the class? (a) 30 (b) 40 (c) 60 (d) 15 (e) 35

A student is picked at random from the class. What is the probability that the student made

37. No error (a) $\frac{1}{5}$ (b) $\frac{2}{5}$ (c) $\frac{4}{5}$ (d) $\frac{3}{5}$ (e) $\frac{6}{19}$

38. Three errors (a) $\frac{1}{5}$ (b) $\frac{7}{40}$ (c) $\frac{4}{5}$ (d) $\frac{9}{40}$ (e) $\frac{3}{40}$
39. Not more than two errors? (a) $\frac{1}{5}$ (b) $\frac{4}{5}$ (c) $\frac{5}{8}$ (d) $\frac{3}{40}$ (e) $\frac{1}{40}$

Use the information to answer question 40, 41, 42 and 43. The six-sided dice are thrown simultaneously. The total of their scores is found. What is the probability that the total is

40. 6 (a) $\frac{3}{10}$ (b) $\frac{5}{36}$ (c) $\frac{5}{13}$ (d) $\frac{5}{18}$ (e) $\frac{4}{15}$
41. Less than 5 (a) $\frac{3}{10}$ (b) $\frac{1}{6}$ (c) $\frac{5}{13}$ (d) $\frac{4}{15}$ (e) $\frac{2}{5}$
42. Greater than 8 (a) $\frac{3}{10}$ (b) $\frac{1}{6}$ (c) $\frac{5}{18}$ (d) $\frac{4}{15}$ (e) $\frac{2}{15}$
43. At least 7? (a) $\frac{3}{10}$ (b) $\frac{1}{6}$ (c) $\frac{5}{18}$ (d) $\frac{7}{12}$ (e) $\frac{2}{15}$

Two numbers are chosen at random from 1,2,3,4. What is the probability that their sum is?

44. Odd? (a) $\frac{2}{3}$ (b) $\frac{1}{3}$ (c) $\frac{2}{5}$ (d) $\frac{2}{7}$ (e) $\frac{5}{6}$
45. Even? (a) $\frac{2}{3}$ (b) $\frac{1}{3}$ (c) $\frac{2}{5}$ (d) $\frac{2}{7}$ (e) $\frac{3}{7}$

Use the information to answer question 46, 47 and 48. The probability that a biased coin will show head is $\frac{3}{4}$. Find the probability that when tossed twice is shows

46. Two heads (a) $\frac{9}{10}$ (b) $\frac{9}{13}$ (c) $\frac{11}{12}$ (d) $\frac{10}{11}$ (e) $\frac{12}{25}$
47. Two tails (a) $\frac{9}{10}$ (b) $\frac{1}{16}$ (c) $\frac{9}{13}$ (d) $\frac{11}{13}$ (e) $\frac{12}{25}$
48. Exactly one head (a) $\frac{9}{10}$ (b) $\frac{1}{6}$ (c) $\frac{2}{5}$ (d) $\frac{3}{8}$ (e) $\frac{2}{7}$

Use the information to answer question 49 and 50. A bookshelf contains 8 detective stories, 7 one science and 3 books on arts. A man selects one at random. What is the probability that:

49. It is a science book? (a) $\frac{3}{8}$ (b) $\frac{1}{6}$ (c) $\frac{7}{18}$ (d) $\frac{2}{7}$ (e) $\frac{11}{13}$
50. It is an arts book (a) $\frac{3}{8}$ (b) $\frac{7}{18}$ (c) $\frac{2}{7}$ (d) $\frac{1}{6}$ (e) $\frac{11}{13}$

APPENDIX 2

CENTRE FOR EDUCATIONAL TECHNOLOGY TEACHER EDUCATION DEPARTMENT UNIVERSITY OF IBADAN, NIGERIA.

Mathematics Students' Attitude Scale (MSAS)

There are no rights or wrong responses to questions on this questionnaire. The questions are about you, what you do and what you feel about Mathematics. All the information you supply will be treated confidentially.

Section A

Sex: Male (), Female ()

Age (years): _____

School: _____

Section B

Express on a four point scale the extent of the agreement between the feelings. Tick (√) the choice which describes your feelings i.e.

- Strongly Agree (SA)
- Agree (A)
- Disagree (D)
- Strongly Disagree (SD)

S/N	ITEMS	SA	A	D	SD
1.	Mathematics is easier for me than most school subjects				
2.	Mathematics is enjoyable				
3.	Nervousness while taking a mathematics test keeps me from doing well				
4.	The more important the mathematics test, the less well I do				
5.	I feel sad when given a Mathematics test to do				
6.	I do not bother about questions involving figures in mathematics				
7.	I find it difficult to talk in front of my mathematics class				
8.	I am not proud of my mathematics school work				
9.	I like to be called on in mathematics classes				
10.	I feel upset in mathematics class				
11.	I always complete my mathematics assignments				
12.	I solve unassigned mathematics problem everyday				
13.	I try to do the best work in mathematics than I can				
14.	I always check for the fact to a mathematics problems				
15.	I think I am doing well in mathematics classes				
16.	I am discouraged with my mathematics school work				
17.	The subject that I enjoyed least is mathematics				
18.	Mathematics is boring				

S/N	ITEMS	SA	A	D	SD
19.	Mathematics is more of enjoyment than its hard work				
20.	Mathematics is the most difficult subject to understand				
21.	If I had my choice, I would not learn mathematics anymore				
22.	Mathematics is hard for me than most people				
23.	I would have liked mathematics better if it were not made so hard in class				
24.	There is so much hard work in mathematics that it takes away the enjoyment in it				
25.	No matter how much I try I cannot understand mathematics				

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