

Effect of computer-simulated experiment on senior secondary school students' anxiety level and performance in practical physics in Owerri Municipal, Imo State, Nigeria

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Abstract

This study provided information on how anxiety in learners could be managed using appropriate instructional strategy. It adopted a pre-test – post-test, control group quasi-experimental design. Multi-stage random sampling technique was used to select 264 SS II students from three secondary schools in Imo State. Participants were randomly assigned to treatment groups: Computer-Simulated Experiment (CSE), Computer-Simulated and Hands-on Experiment (CSHE) and Conventional Hands-on Experiment (CHE). The instruments used to collect data were; Physics Achievement Test ($r = 0.84$), Physics Anxiety Questionnaire Scale ($r = 0.95$), Numerical Reasoning Ability Test ($r = 0.90$) and Perceptual Reasoning Ability Test ($r = 0.91$). Physics Practical Test ($r = 0.84$). Three null hypotheses were tested at 0.0 level of significance. Data was analyzed using MANCOVA. Treatment had significance effect on achievement and anxiety ($= 0.99$, $F_{(4,524)} = 3.72$, $P < .05$, $\eta^2 = 0.028$). Numerical ability had significant effect on performance ($= 0.93$, $F_{(8,524)} = 2.51$, $P < .05$, $\eta^2 = 0.027$). Treatment had interaction effect of numerical and perceptual reasoning ability ($= 0.93$, $F_{(8,524)} = 2.51$, $P < .05$, $\eta^2 = 0.037$). Anxiety in learners could be managed with appropriate instructional method.

KEY WORDS: *Computer-simulated experiment, Anxiety level, Hands-on experiment, Numerical reasoning ability, Perceptual reasoning ability*

Introduction

Anxiety is defined as intense, persistent worry or fear about everyday situation or activity. It involves repeated episodes of sudden feelings of fear, terror, uneasiness which might reach its peak within minutes (Sahin, Caliskan, & Dilek, 2015). Anxiety is a very important construct in the affective domain that has contributed to a large extent in the career choice of learners and their general performance over the years. It is very interesting to state that learners operating with anxiety in their learning environment may not recognize it although it could help the learners to get things done because anxiety – creating situation may sometimes enhance learners' performances. Researchers have classified anxiety as negative and positive in dimension, this they referred to as debilitating achievement anxiety and facilitating achievement anxiety (Bigdeli, 2010). They further stated that although low level of anxiety could have positive effect on achievement and high level of anxiety may severely impede it. The method of teaching the subject could be too formal to the extent of imposing fear and anxiety

on the learners. An anxious learner would not be able to pose questions for further clarification during lessons or instruction for fear of been mocked or booed by the teacher or fellow students. Anxiety could present itself in various forms such as insomnia, weight loss, fainting, over feeding, tingling arms and legs, dizziness, headache, shortness of breath. The lists are inexhaustible. When the symptom becomes more intense than the events, it poses as impediment to learning.

Physics anxiety is an unpleasant emotional state of uncertainty, apprehension, and uneasiness, experienced by the learner in the cause of learning Physics. It is different from science anxiety, which is a diffuse or vague, or negative feeling which arises in science learning situation generally. A learner might also be very comfortable with mathematics but threatened by science or physics anxiety.

Instructional strategy which focuses only on the cognitive aspect of instruction without considering the affective domain of learning

may not achieve their set goal or objectives (Sahin, 2015). That is why it is important for the teacher to investigate ways or strategies that could be used for effective lesson delivery. One of the learning strategies that focus on both cognitive and affective domains of learning is Computer-simulated experiment.

Computer-simulated experiment is a highly interactive, web-based instructional strategy that engages the learners by using virtual laboratory environment which they have not experienced before in the conventional laboratory type of experiment. It is an active learning process where the learner is mentally challenged to reasoning critically while manipulating the virtual apparatus as in the real hands-on experiment. It is one of the modes of web-based learning strategies where the learner is in charge of the entire learning process with little guidance from the teacher. Many academic bodies and institutions have produced, validated and uploaded Computer –simulated experimental software for public uses. The foremost group that has carried out extensive research and validation of CSE is the Physics Educational Technology (PHET) based in the University of Colorado, USA). These are the groups of scientists, educationists, computer software engineers and other relevant group that came together for the purpose of the PHET project. In many secondary schools the exposure to science process skills are limited due to lack of equipment (Nwachukwu 2012). This factor has negated the true nature of science and the goals of Physics practical in secondary school curriculum. Therefore, whenever the learner is faced with the reality of doing science, anxiety sets in especially in an environment where many secondary schools lack equipment and teachers.

Adegoke and Chukwunenye (2013) asserted that poor performance has been attributed to poor instructional techniques and computer-simulated experiment is a mode of web-based instructional strategy that may hold the key to effective learning of Physics. It is one of the modes of web-based learning which has been recently lauded for its ability to improve the teaching of difficult and abstract concepts in sciences and Physics in particular (Allesi & Trollip, 1991). According to Allesi and Trollip

(2001) and Chukwunenye (2018), computer-simulated experiment has a way of introducing cues and prompts which make abstract concept more concrete than any other known instructional strategy and at the same time arrest the interest of the learner. Technological advancement like tsunami has swept across the globe leading to highly innovative pedagogical skills and application to learning and instruction. Computer simulated experiment provides coherent, systematic and highly interactive approach to teaching and learning to the extent that it serves as good tools for scaffolding to improve learning outcome. It provides more opportunity for feedback, reflection, revision as well as new platform for learners (Chukwunenye, 2018).

Numerical reasoning ability, according to Adeleke (2010), is the ability to reason with numbers. It is the knowledge of skills required to apply arithmetic operations either singly or in sequence. Numerical reasoning ability is measured by numerical reasoning ability test. This test was designed to measure the level of ability of students to carry out four processes of cognition which are recognition of constant, variable classification, ordering and recognition of correspondence in dealing with arithmetic numbers (Adeleke, 2010). The word, 'numeracy', according to United Kingdom Committee on Education (UKCE) is proficiency in numbers. Studies have shown a very strong correlation between numerical reasoning ability and achievement in Physics (Adesoji, 2008)

Perceptual reasoning ability is part of the performance Intelligent Quotient (IQ) test always presented in the forms of picture completion, block design, matrix reasoning as perceptual index or subset of Wechsler adult intelligent scale (WAIS) in the fourth version. The perceptual reasoning ability measure the learner's ability to form perceptual relations or create a mental picture of the object in focus. Examples are the learner ability to locate a non-parallax condition and measure angles accurately in order to obtain accurate readings. It also involves the ability of the learner to find relations between verbal and non-verbal reasoning cues by drawing conclusion between a set of activities. The success of a Physics

classroom instruction partly lies on the ability of the learner to demonstrate a good perceptual reasoning ability especially in physics classroom activities. There are many instruments used to measure perceptual reasoning ability but the most appropriate for this work is Raven's Standard Progressive Matrix (SPM).

Statement of Problem

Research had shown that Physics anxiety among learners has posed serious threat to the academic achievement of learners. This Physics anxiety which generally manifests in Physics classes and Physics examination in their various forms includes crippling panic and other feelings that are sometimes not noticed by students and generally ignored by teachers but usually pose a problem to learning in Physics classrooms. It has also been reported that students experiencing science or Physics anxiety are generally calm and productive in their non-science courses. Since anxiety appears to be a normal response to stressful conditions when encountered in classroom teaching and learning, it became expedient to investigate how computer-simulated experiment could be used to manage the level of Physics anxiety in learners to enhance students' achievement in Physics.

Research Hypotheses

The following hypotheses guided the study

1. There is no significant effect of treatment on anxiety and performance of students in Physics practical.
2. There is no significant effect of treatment and numerical reasoning ability on anxiety and performance scores of students in Physics practical
3. There is no interaction effect of treatment, numerical and perceptual reasoning ability on anxiety and performance of students in Physics practical

Theoretical Framework

The theoretical framework for this study is based on engagement theory which was propounded by Greg Kearley and Ben Shneidamann in 1999. They posited that

engagement is said to have taken place when learners meaningfully undertake a task with related interest and got immersed so much as to continue the task with persistence and commitment it deserves because of values attributed to the task. This theory emerged from the experience of teaching with electronic and distance learning environment (Kearley & Shneidamann, 1999). The three components of the learning activities are; (i) relate: which implies learning through collaboration. It discusses the importance of collaboration in learning process; this implies that the educational activities must emphasize team efforts. This is because with team work, students are made to clarify and verbalize their problems (ii) create: involves learning using project-based approach. It explains the essence of project-based learning. The learner in this context focuses effort on application of ideas to a specific context. This type of activity appears to be more interesting to the learner than answering sterile textbook problems. More so, the learner defines the nature of the project even though the learner may not choose the topic, they have a sense of control over their own learning which is absent in the traditional classroom instruction. (iii) donate: involves learning with an outside focus in view. It describes the need for the projects to have a meaningful and realistic focus. It stresses the value of making meaningful contribution while learning. In all these, the proponents have cautioned instructors to ensure that the projects are appropriate for the students and should not have time constraints. This theory is relevant to this work because computer-simulated experiment would naturally engage the learner even beyond the classroom environment especially for learners that have access to Internet facilities at home and continues the activities beyond the classroom. Outside the classroom environment there are opportunities to "relate" and collaborate with people. This kind of collaboration could lead to creativities within and beyond the area in question.

Methodology

A 3x 3x3 pre-test, post-test, control group, quasi-experimental design was adopted for the study in which computer-simulated experimental group

(CSE), combination of computer-simulated and hands-on experimental groups (CSHOE) and hands-on experimental group (HOE) were independent variables and anxiety and interest were dependent variables. A total of 291 Physics students in senior secondary school II took part in the study. CSE group = 124, CSHOE group = 77 and HOE group = 77. Multistage sampling was used to select 291 students of intact classes of SSS II from three secondary schools in Owerri municipal Local Government Area of Imo State. Participants were randomly assigned to treatment groups. Treatment lasted for six weeks. The instrument used were; Physics Achievement

Test ($r = .90$), Numerical Reasoning Ability Test ($r = .90$); Perceptual Reasoning Ability Test ($r = 0.87$), Physics Practical Test (PPT), ($r = .92$) and Physics Anxiety Questionnaire ($r = .95$). Data was analysed using MANCOVA.

Physics Achievement Test (PAT) was prepared by the researcher comprising of fifty objective test items. Each item consists of four options (A,B,C,D). The questions were meant to seek information on the knowledge acquired by the learners in relation to the concept or task in view which were refraction on prisms and verification of Hooke's law. The test items were developed based on content areas, the topics in question were well reflected and the approximate level of cognition as recommended by bloom's taxonomy of educational objectives which were knowledge, comprehension and application was based on their age and class. The questions were administered to some secondary schools that were not part of the study for validation. 20 items out of a pool of fifty test items were selected. The test retest reliability method was used to measure the reliability level of test items which were 0.88 and 0.86 respectively. The internal consistencies of the test were also determined using Kuder Richardson 20 formula and the coefficient was 0.86.

Physics Practical Test (PPT): This was prepared based on Hooke's law and prisms. It is a hands – on experiment . It was adapted from past West African examination practical on the selected topics. It was used to assess students'

demonstration of scientific skills which included taking accurate reading, recording of data, observations, plotting of graph, problem solving skills and many others. The questions were modified to reflect areas that dealt with the concept in view. The reliability coefficient of 0.84 was obtained using KuderRichardson 20 (KR 20) after the instrument was administered to some students who were not part of the study.

Numerical Reasoning Ability Test (NRAT): This was developed by Hamley 1934. It was used by Beret and William in 1997, and Adegoke in 2003. It is an instrument used to determine the ability of learners to reason with numbers or acquire mathematical ability. It was designed to measure the ability of the learner to carry out four cognition processes which are recognition of constant, variable classification, ordering and recognition of constant correspondence in dealing with arithmetic of numbers. It consists of 15 items with options (A,B,C,D). The score of students in numerical reasoning ability test provides the index of numerical ability in terms of high, medium and low. Using percentiles: High = 66.68% - 100%; Medium = 33.4% - 66.67%; Low = 0 - 33%. The reliability of this instrument was reported to be 0.90.

The researcher revalidated this instrument by administering the modified form to some senior secondary school II students of Physics who were not part of the study. The reliability index of 0.90 was obtained using Kuder Richardson formular 20 (KR 20).

Perceptual Reasoning Ability Test (PRAT): This is an instrument used to measure the ability of the learner to create a mental picture of objects or figures in focus. These perceptual components are usually measured as component of Spearman "g" usually referred to as general intelligence (Raven, 1983). In this test, students were usually asked to identify the missing elements or components that complete a pattern which will usually display the learner's perception of these incomplete figures. The missing elements needed to complete the pattern will usually be presented in the form of 4 x 4; 3 x 3 or 2 x 2 matrixes. Hence the name, Raven's progressive matrix. There are three forms of Raven's Progressive Matrix but the one suitable

for this study is standard progressive matrix (SPM). The scales consist of 60 problems divided into five sub-sets of 12 each. The learner is to select the pattern or pieces that fitted best into the overall matrix. For this study, 3 questions were selected from each of a sub-set of five from a total of 12 set, this gave a total of 36 questions in all. The reliability coefficient of this instrument was 0.84 while the scores correlation with other intelligence test ranges from 0.7 to 0.80 (Raven and Court 1983). Raven's standard progressive matrix is the most commonly and widely used instrument for assessing this aspect of intelligence (Adegoke, 2003).

Validation of Instrument: The researcher revalidated the instrument by administering it to some secondary school students that were not part of the target population and the reliability was found to be .91. The scores obtained were used to place learners into three groups of high = 66.68% - 100%, medium = 33.4% - 66.67% and low = 0 to 33% perceptual ability using percentiles.

Software Package on Computer-Simulated Experiment: These are software applications usually made available as virtual online laboratory tools or application. They could either be directly used through the web or as virtual tools downloaded to the computer as offline virtual laboratory tools. This software is used to carry out virtual laboratory experiment using virtual tools or apparatus. The CSE software package has been tried, tested, validated and constantly updated by various prominent groups of educational consultants around the world. Prominent among these groups are Physics Education Technology Project (PHET) constituted of a team of scientists, science educators, software engineers based in the University of Colorado USA. They have validated over 80 SIMS as at 2009. The software package for Hooke's law and prism used in this study was developed by PHET project based in University of Colorado USA and Merlot web masters.

Physics Anxiety Rating Scale (PARS): This is an instrument originally designed to measure Physics anxiety of university students in Physics classes. It is a research-based instrument designed to measure anxiety level of students at

any desired point during instruction. It is a 44-item scale with five options which was modified to four options scale for the purpose of this research. The original reliability value of PARS was 0.95.

Validation of Instrument: The instrument was revalidated by administering it to some secondary school students who were not part of the study and the reliability of 0.95 was obtained using Cronbach Alpha.

Procedures: The procedures for the three groups in this study were:

Experimental Group I: Computer – Simulated Experimental Group (CSE)

Step I: Presentation of concept

Activity I: Introductory class and demonstration of experiment using real apparatus by the teacher.

Activity II: Students brainstormed on problem or task to identify underlying tasks and concept involved and also asked questions.

Step II: Performance of Task by the teacher

Activity I: Steps involved in logging into the Internet virtual laboratory were presented to the learners using projector.

Activity II: Learners brainstormed on the procedures involved and asked questions to clear misconception on task to be performed.

Activity III: Concept was demonstrated, and readings taken as teacher entertained questions in every step involved.

Step III: Grouping of students

Activity I: Students were grouped in 3s and assigned a computer in order to take individual readings.

Step IV: Performance of tasks by the students

Activity I: Students embarked on the given task in turn which involves using only computer simulations to obtain a set of reading using the computer while trained research assistant goes around to monitor the activities.

Step V: Presentation of findings

Activity I: Students used data obtained to make a table of readings, plotted graphs and solved other problems arising from the task

Step VI: Submission of Papers

Step VII: General Discussions based on the task performed

Experimental Group II: Computer-Simulated and Hands-on Experimental Group (CSEHOE)**Step I: Presentation of concept**

Activity I: Introductory class and demonstration of experiment using real apparatus by the teacher

Activity II: Students brainstormed on problem or task to identify underlying task or concept involved and also asked questions

Step II: Performance of task by the teacher

Activity I: Set up the apparatus in steps as student watched while the teacher took readings

Activity II: Students brainstormed on the activities performed by the teacher and asked questions

Step III: Grouping of learners and task performance

Activity I: Students grouped in threes and encouraged to take individual readings as trained research assistant moved round to monitor the activities

Step IV: Presentation of further problems

Activity I: The teacher carried out the steps involved in logging onto the Internet virtual laboratory while the learners watched the teacher

Activity II: Learners brainstormed on the procedures involved and asked questions to clear misconception on task to be performed

Step V: Performance of task by the students

Activity I: Students repeated the activities as performed by the teacher which involves using the laboratory

apparatus to obtain one set of reading and secondly, using the computer simulation to obtain another set of reading while the research assistant moved round to monitor the activities

Step VI: Submission of paper

Activity I: Students used data obtained to make table of readings, plotted graphs and solved other problems arising from the given task and submitted their workbook

Experimental Group III: Hands-on Experimental (HOE)**Step I: Presentation of concept**

Activity I: Introductory class and demonstration of experiment using real apparatus by the teacher

Activity II: Students brainstormed on problem or task to identify underlying task or concept involved and asked questions

Step II: Performance of task by the teacher

Activity I: The teacher set up the apparatus in steps as students watched while the teacher took readings

Activity II: Students brainstormed on the activities performed by the teacher and asked questions

Step III: Grouping of learners and task performance

Activity I: Students grouped in threes and encouraged to take individual readings as trained research assistant moved round to monitor the activities

Step IV: Presentation of findings

Activity I: Students used data obtained to make table of readings, plotted graphs and solve other problems arising from the given task and submitted their workbook

Activity II: The scores obtained were coded and analysed using MANCOVA as statistical tools through the use of SPSS version 20 with pre-test as covariate.

Results

Table 1: MANCOVA Summary Table

Multivariate Tests ^a							
Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Wilks'	.254	384.271 ^b	2.000	262.000	.000	.746
	Lambda						
PrePhysics Score	Wilks'	.998	.198 ^b	2.000	262.000	.820	.002
	Lambda						
TREATMENT	Wilks'	.946	3.722 ^b	4.000	524.000	.005	.028
	Lambda						
Numerical Ability	Wilks'	.946	3.667 ^b	4.000	524.000	.006	.027
	Lambda						
Perceptual Ability	Wilks'	.971	1.947 ^b	4.000	524.000	.101	.015
	Lambda						
TREATMENT * Numerical Ability	Wilks'	.960	1.357 ^b	8.000	524.000	.213	.020
	Lambda						
TREATMENT * Perceptual Ability	Wilks'	.945	1.868 ^b	8.000	524.000	.063	.028
	Lambda						
Numerical Ability * Perceptual Ability	Wilks'	.928	2.511 ^b	8.000	524.000	.011	.037
	Lambda						
TREATMENT * Numerical Ability * Perceptual Ability	Wilks'	.938	1.074 ^b	16.000	524.000	.377	.032
	Lambda						

Table 2: Univariate ANCOVA summary of between subjects' effects

Tests of Between-Subjects Effects							
Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared
Corrected Model	PHYSICS	369.214 ^a	27	13.675	1.588	.036	.140
	ANXIETY	10061.644 ^b	27	372.653	2.209	.001	.185
Intercept	PHYSICS	1359.188	1	1359.188	157.816	.000	.375
	ANXIETY	104344.993	1	104344.993	618.473	.000	.702
Prephysics	PHYSICS	3.206	1	3.206	.372	.542	.001
	ANXIETY	4.101	1	4.101	.024	.876	.000
TREATMENT	PHYSICS	121.199	2	60.599	7.036	.001	.051
	ANXIETY	189.981	2	94.990	.563	.570	.004
Numerical Ability	PHYSICS	3.513	2	1.756	.204	.816	.002
	ANXIETY	2456.006	2	1228.003	7.279	.001	.052
Perceptual Ability	PHYSICS	2.024	2	1.012	.118	.889	.001
	ANXIETY	1287.190	2	643.595	3.815	.023	.028
Numerical Ability * Perceptual Ability	PHYSICS	27.716	4	6.929	.805	.523	.012
	ANXIETY	2907.724	4	726.931	4.309	.002	.062
Error	PHYSICS	2265.081	263	8.612			
	ANXIETY	44371.744	263	168.714			
Total	PHYSICS	12671.000	291				
	ANXIETY	742775.000	291				
Corrected Total	PHYSICS	2634.296	290				
	ANXIETY	54433.388	290				

a. R Squared = .140 (Adjusted R Squared = .052)

b. R Squared = .185 (Adjusted R Squared = .101)

KEY:

NA = Numerical Reasoning Ability
 PA = Perceptual Ability
 Treatment*NA = Interaction Effect of Treatment and Numerical Reasoning Ability
 Treatment*PA = Interaction Effect of Treatment and Perceptual Reasoning Ability
 NA*PA = Interaction Effect of Numerical and Perceptual Reasoning Ability
 Treatment*NA*PA = Interaction Effect of Treatment Numerical Reasoning Ability

Hypothesis One: There is no significant main effect of treatment on anxiety and achievement scores of students in Physics practical.

To test the hypothesis for the main effect of treatment on the combined dependent variables of achievement and anxiety, we used table 1. From table 1, it was observed that the effect of treatment on achievement and anxiety was significant (Wilk's Lambda = 0.946); $F_{(4,524)} = 3.72$ $P < .05$, partial $\eta^2 = 0.028$. Since the result of multivariate test was significant, a univariate ANCOVA was carried out after a Bonferroni type adjustment at 0.025 alpha level. It was observed that treatment had significant effect on achievement, $F_{(2,263)} = 7.036$, $P < .05$, $\eta^2 = 0.051$ but no significant effect on anxiety $F_{(2,263)} = 0.563$, $P > .05$, $\eta^2 = 0.004$.

Hypothesis Two: There is no significant effect of treatment and numerical reasoning ability on anxiety and achievement scores of students in Physics practical

From table 1, it was observed that there was a significant main effect of numerical ability on combined dependent variable of anxiety and achievement in Physics (Wilk's Lambda = 0.946); $F_{(4,524)} = 3.67$, $P < 0.05$, $\eta^2 = 0.027$. The result of multivariate analysis for numerical ability was significant, a Bonferroni adjustment to alpha level of 0.025 was made and univariate ANCOVA result showed that there was no significant effect of numerical reasoning ability on Physics achievement $F_{(2,263)} = 0.204$, $P > 0.05$, $\eta^2 = 0.002$, but there was a significant effect on anxiety $F_{(2,263)} = 7.279$, $P < .05$, $\eta^2 = .052$.

Hypothesis Three: There is no interaction effect of numerical and perceptual reasoning ability on anxiety and achievement scores of students in Physics practical

From table 1, it was observed that there was an interaction effect of numerical and perceptual reasoning ability on combined dependent variables of anxiety and Physics achievement was significant (Wilk's Lambda = .928), $F_{(8,524)} = 2.51$, $p < .05$, multivariate squared eta squared = $\eta^2 = .037$.

From table 2, a univariate ANCOVA after Bonferroni adjustment at alpha level of .025 shows that interaction of numerical ability and perceptual ability has no statistical significant effect on Physics achievement $F_{(4,263)} = .204$, $p > .05$, eta squared = $\eta^2 = .012$, but there was a significant effect on anxiety $F_{(4,263)} = 4.309$, $p < .05$, eta squared = $\eta^2 = .062$

To disentangle the interaction effect of numerical and perceptual ability on anxiety, a graph was plotted. The graph is shown in figure 1:

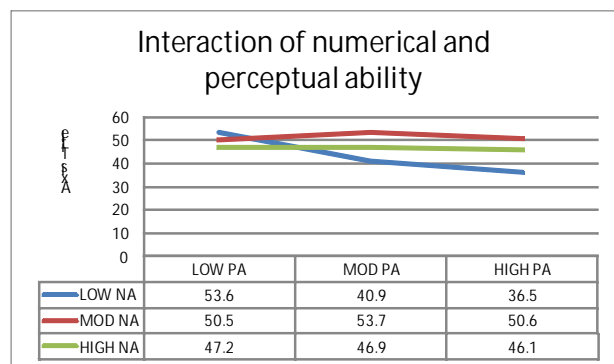


Figure 1: Graph showing interaction effect of numerical and perceptual ability on anxiety

The graph was also used to disentangle the observed interaction. From Fig. 1 It was quite evidence that students who have moderate numerical ability and moderate perceptual ability has the highest score(53.7) in physics

achievement test followed by students who have low numerical reasoning ability and low perceptual reasoning ability (53.6). The graph shows that students with low numerical reasoning ability and high perceptual reasoning ability have the least score (36.5) in physics achievement test.

Discussion, Conclusion and Recommendations

The main purpose of this study was to find out which learning strategy helps to control the level of anxiety in Physics class. It also intended to find out if the unlearned mathematical ability in the form of numerical reasoning ability has any role to play in controlling the level of anxiety in learning Physics. It was also discovered that Computer-Simulated Experiment (CSE) could be used to reduce the level of Physics anxiety in learners more than conventional hands-on experimental group while the achievement level of learner is maintained. The result also showed that the level of numerical reasoning ability affected anxiety level of students especially for low and moderate ability group in Computer-simulated experimental group. This is in agreement with Adegoke and Chukwunonye (2013) that revealed that Computer-Simulated Experiment is the best for low numerical and moderate perceptual reasoning ability group.

It was equally revealed that Computer-Simulated Experiment has an interaction effect on students for low numerical and moderate perceptual reasoning ability group. This implies that students with low numerical reasoning ability and moderate perceptual reasoning ability benefit maximally. This is in agreement with Zacharia and Anderson (2003) and Yu Fee-Lee, Yu Ying Guo and Hsiang Ju (2008) who reported that using a combination of Computer-Simulated Experiment and Hands-On Experiment could help students make reasonable predictions and interpretation from the right perspective more than students taught using hands-on alone.

It was therefore concluded that anxiety in Physics could be properly managed with the proper use of Computer-Simulated Experiment even if the learner does not have an excellent numerical reasoning skills. It was therefore

recommended that computer-simulated experiment should be introduced into secondary school system. Also, priority should be given to reducing anxiety level of students in a teaching and learning environment for optimal learning.

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