

EFFECTS OF SELF-REGULATORY STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' PRACTICAL SKILLS IN BIOLOGY IN OYO STATE NIGERIA.

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Abstract

The research concerns itself with the effects of self-regulatory strategy on senior secondary school students' practical skills in Biology in Oyo state Nigeria. The moderating effects of mental ability and learning style were also examined. The study adopted quasi-experimental of pretest, post-test, control group research design. The following research instruments were used for the study Biology Practical Skills Rating Scale (BPSRS), Student Mental Ability Test (SMAT), Student Learning Styles Questionnaire (SLSQ), Teachers' Instructional Guide on Self-regulatory Strategy (TIGSRS), Teachers' Instructional Guide on the Conventional Strategy (TIGCS), Evaluation Sheet for Assessing Teachers' Performance on Self-regulatory Strategy on pollination and reproduction in plants (ESATPSRS) and Conventional Strategy on pollination and reproduction in plants (ESATPCS). Three null hypotheses were tested at 0.05 alpha level. Data was analysed using ANCOVA. There was a significant effect of self-regulatory strategy on students' practical skills in biology ($F_{12,278} = 7.95$; $P < 0.05$, $Partial N^2 = 0.05$). It was recommended that Curriculum planners and developers in science courses for secondary school should emphasize on the need to continuously use innovative strategy such as Self-regulatory Strategy to enhance science based instruction.

Keywords: Self-regulatory Strategy, Conventional strategy, Student Mental Ability, learning style and students' practical skills in biology

Introduction

Biology is an important subject among the core science subjects taught at senior secondary school level in Nigeria. Biology as a subject occupies a unique position in the School curriculum. Biology is introduced to students at secondary school level as a preparatory ground for human development where career abilities are groomed (NERDC, 2013). The importance of Biology in the industrialization and other sector of the economy cannot be overemphasized. As a matter of fact, it is a prerequisite for pursuing a number of

careers in sciences which include medicine, pharmacy, biochemistry, botany, nursing, zoology among others.

The learning of Biology provides an individual with useful information in solving everyday life challenges. Studies have shown that the knowledge of Biology contributes towards the socio-economic development of a country (Ogundiwin, 2013). The goals of teaching Biology as documented by the National Policy on Education (NERDC, 2013) are highlighted as follows:

- Acquisition of manipulative skills to enable students carry out experiments and projects in Biology.
- Acquisition of scientific skills and processes such as observation, classification, and interpretation among others.
- Acquisition of scientific attitudes for problem solving such as curiosity, scepticism, open mindedness, and objectivity among others.
- Ability to apply biological principles in everyday life.
- Provision of foundation for future professions such as Medicine, Nursing, Botany, Zoology, and Agriculture among others

Awareness of nature of things around them (NERDC, 2013).

However, practical skills is an essential part of Biology education. It gives students the necessary skills for higher education and employment, deepens their knowledge of scientific ideas and enables them to engage in the processes of biology. Practical skills is formative as it helps the students to understand science and how the scientific ideas are developed (Watts, 2013). To achieve the goals of biology education, it is imperative that an attempt is made to balance emphasis on both theory and experiments. Experiments in biology illustrate the fact that biology is not a theoretical abstraction as it describes the real world around us. Authors and researchers have identified some factors that are responsible for poor performance in Biology and other related sciences. These factors may cut across all levels of education where Biology is offered. The identified factors include; textbook and laboratory based reasons (Ivowi, 2000), misconceptions of concepts identified (Olagunju and Abiona,

2004; D'Avanzo, 2008), large class size (Olagunju, 2005), and insufficient practical skills (Danmole, 2012).

Self-regulatory strategy is an active and systematic process during which learners specify the aims for their own learning and then try to regulate, control and supervise their cognition, motivation and behaviour (Koivuniemi, Panadero, Malmberg and Järvelä 2016). Self-regulatory strategy is the process by which students take charge of their own learning, monitoring their behaviour and progress and making adjustments along the way. It's the transformation of thought into purposeful action. Students with higher levels of self-regulation are more likely to succeed academically than students with low self-regulation Dignath and Buttner (2008), Rimkaufman *et al.*, (2009). Zimmerman (2001) cognizes self-regulatory learning as a self-controlled process via that learners convert their mental abilities to practical skills related to them homework. Pintrich (2000) stated that students with self-regulation strategy are more motivated in terms of academic success and learn better than other students.

Self-regulatory strategy is the necessary instruments for students' success and have a close relationship with their self-efficacy and the academic development. Self-regulatory strategy, an intervention in which students learn to monitor their own behaviours, offers students methods to manage and take control of their own behaviours (Briesch and Chafouleaus, 2009; DuPaul *et al.*, 2012). Self-regulatory strategy offers many benefits for students in that it provides students with a more accurate picture of the behaviours or progress; provides students with immediate feedback, and facilitates better communication between teacher and

student due to students recognizing their progress.

Mental ability is defined as students' ability to handle quantitative information (Ogunwuyi, 2009). Onabanjo (2007) found a very high relationship with students' mental ability and performance in science related courses. Aina (2006) reported a causal linkage between mental ability and achievement in senior secondary physics. Mental ability has also been found to influence learning of students in science (Olagunju and Chukwuka, 2008; Raimi, 2003). Olatoye and Aderogba (2011) determined the role of students' verbal and numerical abilities on performance of senior secondary school science students in aptitude tests. Two hundred senior secondary school science students participated in the study using three validated research instruments to collect data and regression analysis tool for data analysis. Findings revealed an existence of strong correlation between students' mental ability and overall students' performance.

Learning style is another variable that may affect students' learning outcomes in school subjects. It is known that learning process varies among learners due to the presence of biological and psychological differences (Locke, 2008). Learning styles refers to the concept that individuals differ in regard to what mode of instruction or study is most effective for them (Pashler, McDaniel, and Rohrer, 2009). Connerr (2008) stated that we each have a unique and individual style of learning, thinking and communicating, it's desirable that we interact differently with information. Society needs all kinds of thinkers, with each expressing different mental strengths. Proponents of learning-style assessment contend that optimal instruction requires diagnosing students'

learning style and tailoring instruction accordingly. Learner's experience of learning is not the same. One learner might describe the learning experience in biology as the retention of knowledge by dint of memorisation and repetition, while another might describe it as interpreting meanings and trying to understand reality. The style of learning and the motive for learning rests within the learner and in most cases relates to past experiences. Students learn best by seeing the value and importance of the information presented in the classroom. If the students are not interested in the material presented, they will not learn it. In order to achieve the ultimate goal of student learning it is important to use a combination of teaching methods and to make the classroom environment as stimulating and interactive as possible.

Given the conflicting result on the influence of learning style on learning outcomes, there is therefore need to carry out more research to affirm the conflicting claims. Again, most of previous studies made use of learning style as independent variable but in this study it was used as moderator variable. In an attempt to enhance Biology students' learning outcomes and their mental ability and learning style, this study therefore determined the effects of Collaborative Project-Based learning and Self-regulatory Strategies on of senior secondary school students' Practical skills in Biology in Oyo State Nigeria.

Statement of the Problem

The poor handling of the concepts by teachers who adopt the teacher-centred teaching methods aggravated the problem. Some candidates' weaknesses also include their inability to; draw according to specification and size; classify organisms; understand what observable difference

means; spell technical words correctly; relate the differences in a tabular form together; march structures with functions correctly; draw guidelines to touch the label on the diagram; and label correctly. Efforts to address this problem have led scholars to embark on intervention programmes such as trying efficacy of teaching strategies such as advance organizers, reciprocal teaching and role play among others. Despite these intervention, the attitude of students to biology has not satisfactorily improved, thereby fuelling suspicion that other factors could be responsible. Among such factors are students' learning styles and mental ability which this study investigated.

The presents study therefore adopted Self-regulatory strategies taking into consideration the students' mental ability and learning style and their effects on students' Practical skills in Biology in Oyo state.

Hypotheses

This study tested the following hypotheses at $p < .05$ level of significance.

Ho₁: There is no significant effect of self-regulatory strategy on students' Practical skills in Biology

Ho₂: There is no significant effect of mental ability on student Practical skills in Biology

Ho₃: There is no significant effect of learning style on students Practical skills in Biology

Methodology

The study adopted the quasi experiment pre-test, post-test, control group research design

Participant of the Study

Two Local Government Areas were randomly selected from the eleven local government areas within Ibadan, Oyo state. Two schools were purposively selected from each local

government Area understudy, two schools each for the experimental group and two schools for the control group. Intact classes was used for this study in which all students were purposively selected because this study adopts a pretest-posttest control group quasi-experimental design. A total of four purposively selected schools were used for the study. The criteria for the purposive selection of the schools are as follows:-

Evidence of the school having good and standardized Biology laboratory

Presence of qualified Biology teachers

Evidence of having Biology textbooks

Readiness of teaching staff of the school and students to participate in the study

The school being a co-educational school

Research Instruments

Biology Practical Skills Rating Scale (BPSRS) was adopted from Awolere (2015) by the researcher to investigate students' practical task based on direct observation during their laboratory activities. The biology practical skills rating scale (BPSRS) was used to determine students' ability to manipulate, observe, record, label, classify and draw in practical class. It consist of six point continuum that ranged from zero (0) for total inability to exhibit the skills (Very Poor), to five (5) at the extreme for full exhibition of the skills (Excellent). The face validity of SBPRS was done by showing the items to three science educators with bias in Biology to determine its suitability in term of clarity of ideas, language of presentation, class levels, coverage, relevance, and adaptation to the study. Also reliability coefficient of 0.812 was obtained using Cronbach alpha measure. Also Students Mental Ability Test (SMAT) was adopted from OTIS-LENON (1967) mental ability test used by Aina (2006). The instrument was a 40-item multiple choice with 4 option. This instrument measured the mental ability of

the learners. Kuder-Richardson formula 20 (KR 20) was used for the reliability test and coefficient of 0.821 was obtained. In addition Student Learning Style Questionnaire (SLSQ) of 40 items students scale adopted from O'Brien (1985) to measure the learning styles of selected students was used. All choices correspond to the four sensory modalities which are measured by VARK (visual, aural/auditory, read/write, and kinesthetic). There were two sections; section A sought for demographic data of students, while section B consisted of 40 items which students responded to by expressing their level of agreement. The reliability of the instrument was determined by using Cronbach coefficient which was found to be 0.89

Research Procedure

The students in experimental and control group were administered mental ability test and the learning style questionnaire in order to categorise them according to their mental ability and Learning style group. This was followed by the administration of: Biology

Practical Skills Rating Scale (BPSRS) and from this pre-test was obtained. Immediately after eight weeks of treatment period, this same instrument was administered to the students in their classrooms under the same conditions. The research assistances of the participating classes in each school administered the test under the guidance of the researcher.

Methods of Data Analysis

The data collected were analysed using inferential statistics of Analysis of Covariance (ANCOVA) to determine the significant main and interaction effects with the pre-test scores as the covariates to test the hypotheses. The estimated marginal mean (EMM) of different groups was used to detect the magnitude and direction of differences.

Results

H₀1: There is no significant effect of self-regulatory strategy on students' practical skills in Biology

Table 2: Analysis of Covariance (ANCOVA) of Post-Practical skills by Treatment, Learning style and Mental ability

Source	Sum of Squares	df	Mean square	F	Sig.	Partial Eta Squared
Corrected Model	2036.859	24	84.869	8.175	0.000	0.414
Intercept	3404.280	1	3404.280	327.922	0.000	0.541
Pre practical skills	908.337	1	908.337	87.497	0.000	0.239
Treatment	164.986	1	164.986	7.946	0.000*	0.054
Learning style	8.436	3	2.812	0.271	0.846	0.003
Mental ability	1.949	1	1.949	0.188	0.665	0.001
Error	2886.019	278	10.381			
Total	121292.000	303				
Corrected Total	4922.878	302				

R Squared = 0.41 (Adjusted R Squared = 0.36) *denotes significant $p < 0.05$

Table 2 shows that there is a significant effect of self-regulatory strategy on students' practical skills in biology ($F_{(1,278)} = 7.$

95; $P < 0.05$, Partial $\eta^2 = 0.05$). The effect is 5.0%. This implies that 5.0% variation in students, practical skills in biology was due to the significant effect of treatment. Hence, hypothesis 1 was rejected. To determine the

magnitude of the significant effect in the treatment group, the estimated marginal means of the treatment group were carried out and the result is presented in Table 3.

Table 3: Estimated Marginal Means for Post-Practical Skills by Treatment and Control group

Treatment	Mean	Std. Error
Self –regulatory Strategy(SRS)	19.80	0.40
Conventional Strategy(CS)	17.88	0.59

Table 3 indicates the senior secondary school students taught with self –regulatory strategy (SRS) treatment group (19.80), while the Conventional Strategy (CS) Control group (17.88) had the adjusted post-practical skills mean score in Biology. This order is represented as $SRS > CS$. In order to explore what caused this significant effect.

H₀₂: There is no significant effect of learning style on students' practical skills in Biology

Table 2 indicates that there is no significant effect of learning style on students' practical skills in Biology ($F_{(3,278)} = 0.27$, $P > 0.05$; Partial $\eta^2 = 0.00$). Thus, hypothesis 2 was not rejected. This means that learning style had no effect on senior secondary school students' practical skills in Biology.

H₀₃: There is no significant effect of mental ability on students' practical skills in Biology
Table 2 shows that there is no significant effect of mental ability on students' practical skills in Biology ($F_{(1,278)} = 0.19$, $P > 0.05$; Partial $\eta^2 = 0.00$). Thus, hypothesis 3 was not rejected. This means that mental ability had no effect on senior secondary school students' practical skills in Biology.

Discussion of Findings

The findings of the study revealed that there is a significant effect of self-regulatory strategy on students' practical skills in Biology: students in the Self-regulatory treatment group had higher post mean score while students in the control group had the lower adjusted post mean scores in Biology Practical Skill Rating Scale (BPSRS). Possible reason for this may be because of the active involvement of students in their learning process, which is the basis of assumption of constructivism learning theory on which Self-regulatory Strategy is based. Jegede and Ayeni. (2013) advocated for practical focused approaches in the instruction of Biology.

Self-regulatory learning strategy as used in this study had the highest positive effect on students' practical skill. Students in the Self-regulatory learning group improved in their practical skills more than control groups most likely because they were more engaged in learning process by taking charge of their own learning. Biology practical is centred more on the psychomotor domain than cognitive domain of Bloom's taxonomy, therefore strategy that involves learners participation would help to improve mastery of such skills. It is not surprising therefore to see that Self-regulatory learning group had the higher adjusted post-test mean score. The result also lends credence to the claims of Sams (2010), Nguyen (2012), Jason (2012), Brame (2013) and Miles (2015). These researchers have established that whenever there is peer collaboration, students always enjoy support from each other which is not always available whenever the lesson is teacher dominated. So, when there is peer assistance and support in a practical lesson, mastery of skills are likely to be more than when it is teacher mediated. From the findings of this study, it may therefore be reasonable to conclude

that Self-regulatory learning strategy particularly has the tendency to improve student mastery of practical skill.

The result of the study also showed that learning style had no significance effect on students' practical skill in Biology. This may be as a result of the strategy been student centred which help them to construct their own learning and control their learning behaviour. It may also be due to the help provided by the students with good learning style to the student with poor learning style since each student has the opportunity to collaborate with each other in learning at their own pace. However the study contradict the finding of Deborah, Pamela and Bradford (2005) whose found learning style had effect on academic performance.

The findings also showed no significance difference of mental ability on students' practical skill. This may be as a result of liberty by the students to monitor their own behaviours, manage and take control of their own behaviours which allow self-pacing, an important fact to enable learners to learn according to their individual pace and that will insure both groups of students to perceive information equally. This in agreement with the findings of Ogunleye (2015), Grace and Raheem (2011) that when students in low mental ability control their learning and seek help from high mental ability it improves their performance. However the finding disagree with work of Onabanjo (2007) and Morribend (2004) that mental ability had significant effect on students' academic performance in Biology.

Conclusion

The result of the study had shown the Self-regulatory Strategies is more effective in enhancing students' level of practical skill in Biology than the Conventional Strategy. When secondary school students are

exposed to strategies where experience/ explorations are hands on, mind on, structured and are guided by the teacher, it fosters the scientific knowledge and skills of students better than conventional strategy. Self-regulatory Strategies produced better practical skill in Biology concepts than the conventional method. This means that the usual inability to cover the voluminous Biology topic/ contents in the stipulated time and the usual poor Biology practical skill resulting from insufficient practical resources which often lead to poor performance in Biology could be effectively tackled through the application of Self-regulatory Strategy. The study also showed that learning carried out with students largely in charge of their learning can lead to greater practical skill of students in Biology. Furthermore it showed that mental ability and learning style had no effect on students' practical skill in Biology which may due to the ability of students to take charge of their learning and behaviour in classroom situation.

Recommendations

Based on the findings of this study the following recommendation are made

- The Government and other Stakeholders in Education should collaborate with bodies such as science teachers association of Nigeria (STAN), Nigeria Union of Teachers (NUT) and so on to organize in –service training for biology and other subject teachers to acquire necessary and adequate knowledge need in the practice of instructional strategies such as self-regulatory strategy.
- Biology teachers must endeavour to match instructional strategies with the manner in which students receive and process information.

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