ASSESSMENT OF THE EFFECTS OF PROBLEM-SOLVING APPROACH ON STUDENTS' PERFORMANCE IN BASIC SCIENCE IN JUNIOR SECONDARY SCHOOLS IN KADUNA STATE, NIGERIA

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Abstract
The study assessed the effects of Problem-Solving methods on students' performance in basic science in Junior Secondary Schools in Kaduna State, Nigeria. The study adopted quasi experimental research design. The target population of the study was made up of 119,238 Junior Secondary Students School Students in Kaduna State, of Nigeria. The sample size for this study consisted of two (2) intact classes of 146 Junior Secondary School students. Purposive sampling technique and was used to choose the sample size. The instrument used for data collection in the study was adopted and test of multiple choice in Basic Science Junior Secondary Certificate Examination, 2010-2014. The validated instrument was pilot tested and a reliability coefficient of 0.79 was obtained. The statistical tools used for data analysis included descriptive statistics mainly Mean and Standard Deviation which were used to answer the research questions raised in the study. The t-test statistic was used to test the new hypotheses. The study established among others that the post-test performance of students taught Basic Science using Problem-Solving method was better than the pre-test. Also, students that were taught Basic Science using Problem-Solving methods had a higher score and significantly performed better than their counterparts who were taught using conventional method. The study recommended that Basic science teachers should be encouraged to use problem-solving approach because of its positive effect in enhancing students' academic performance. Curriculum planners, school managers, Communities, Non-governmental organizations and Ministry of Education at Federal, State, and Local Government levels should incorporate and support the use of problem-solving methods in teaching Basic Science at junior secondary schools.

Keywords: Problem-Solving methods, performance, Conventional method, Basic science

Introduction

Teaching is an interactive process through which knowledge and skills are shared with students with a view to improving understanding and ability to bring about desirable learning. Thus, teacher initiates the communication and interactions through proper instructional process and methods. The Federal Republic of Nigeria (FRN, 2013) in the National Policy on Education emphasized the appropriate choice of teaching method and strategy by teachers so as to solve educational problem and enhance students' learning.

Basic science is considered paramount and necessary for all students as the present modern civilization is a Scientific civilization where the modern society is completely drawn by the Scientific environment where Science has become an integral part of our lives and living in many ways: health, agriculture, nutrition, energy production, transportation, and education just to mention a few. The Federal Republic of Nigeria in the National Policy on Education (FRN, 2013) stated that Science Education shall emphasize the teaching and learning of science process and principles, so that it can achieve the overall objectives of Basic Science curriculum which are to enable the learners: develop interest in Science and technology; acquire basic knowledge and skills in science and technology; take advantage of numerous career opportunity offered by Science and Technology, and become prepared for further

studies in Science and Technology. For these objectives to be achieved, what comes to mind is the need for the use of effective teaching methods.

There are varieties of teaching methods depending on the situation, learner's level as well as the subject matter. The teaching methods can be teacher centred, learner-centred or a mixed approach. Omeogun and Akani (2014) described teacher-centred as a method which the teachers serve as the express authority in presenting information. One of the methods of teacher centred used among others is the Conventional (Talk and Chalk) method which is said to be used largely by many Science Teachers (Atadoga & Onaolapo, 2008 in Dawaki, 2014). About 80% of scientific information or principles that students receive from their teachers came through this method as the educational system puts so much premium on paper qualifications, Science Teachers embraced the conventional lecture method as it helps in coverage of School syllabus as information is more easily disseminated and allow easy handling of large classes.

Problem-solving approach involves the identification of a problem for students to solve with minimum guidance from the teacher, it is a type of teaching and learning where students work with each other to solve complex and authentic problems. Problem solving exposes students to the task of reasoning, self-assessment of skills, reflective ability its help students to task their thinking abilities in order to find solutions to problem. That is why the researcher seeks to find out whether problem-solving method might have a positive impact over the Conventional lecture method on students' performance in Basic Science. Idris (2014) that students taught using problem-solving strategy achieved significantly better than those that were taught using lecture method; in terms of retention there was significant difference between students taught Basic Science using problem-solving teaching strategy than those taught using the lecture method. Adeniran (2013) added that the students exposed to the problem solving approach (PSA) performed significantly better than those exposed to the lecture method (LM). Since studies by various researchers such as Abdullahi (2013), and Ezeaghasi (2014) revealed that Conventional teaching method does not promote effective Science learning and as a result it might lead to poor performance in the various Science subjects. The poor performance of students in Junior Secondary Schools, in Basic science in Kaduna State, Nigeria, as stated by Ministry of Education Resource Centre, for instance, the percentage pass at credit level in the year 2010, 2011, 2012, 2013 and 2014 are 29%, 42%, 34%, 46% and 37% respectively.

The Conventional method involves verbal presentation of ideas, concepts, generalization, and facts by the teacher who does most of the activities in form of talking while students are either passive listeners or slightly involved. The method is said to be ineffective in teaching Basic Science as it does not promote active learning of science through 'minds on, hands on' more so, the Conventional lecture method of Chalk and talk that is largely used by most teachers are challenged for their inability to foster critical thinking, holistic learning environment among learners and does not consider individual differences existing in each class as their abilities vary considerably and thereby not meeting the different needs of the students (Gadzama, 2012; Maheshwari, 2017; Shafiu, 2014). Rousseur in John (2014) pointed out that the learner should be capable of learning rather than the learner being made a dumping ground for every information the teacher intends to pass across which makes learning uninspiring. Kenedy (2017) stated that in most advanced countries gone are the days where the teacher stands at the front of the classroom before a blackboard leading a class as a sole conveyer of information. Rather the students are involved in the learning of science processes skills such as observation, measuring, inferring, interpreting data, formulating questions/hypotheses in addition to cultivating scientific attitude that the

students are expected to display while working such as curiosity, open-mindedness, empiricism which is finding out things by doing and parsimony.

The call for the Student-Centred approach which according to (National Teachers Institute, 2012), appealed to the needs and interest of the learner, thereby motivating continuous learning. The focus is on learner, encourage participation and interaction throughout the lesson period, gender sensitive, collaborative as well as encourage critical thinking. The student-centred approach therefore is said to be the current thinking about teaching that is active, constructive in which the teacher assumes the role of a guide by emphasizing the learner, guiding the learner, and promoting learner development.

Poor performance of students in Basic Science in Junior Secondary Schools Certificate Examination in Kaduna State, Nigeria is of great concern to most science educators. There has been poor percentage pass at credit level in the year 2010, 2011, 2012, 2013 and 2014 as 29%, 42%, 34%, 46% and 37% respectively (Ministry of Education Resource Centre, 2016).

It should be noted that the nature of Science is far more than an understanding of Science content but rather development of a range of process skills and values to enable students to solve problems. This is due to the challenges presently facing the teaching of Science as the teachers employ teaching method that is Teacher-Centred, where the students are required to memorize more in a passive way. It is sad observing that most Science Students after completion of their secondary school could not solve simple problems of scientific processes such as simple measurement involving fundamental quantities and their units, inability to read simple instrument such as thermometer as observed by the researcher while teaching science education at Nigeria Certificate in Education level.

Furthermore, majority of students in secondary schools are unable to make connections between what they are learning and how that knowledge could be used. This could be due to extreme emphasis on content coverage using the Conventional Lecture method comprising of "talk and chalk" method neglecting the Activity method and Problem-Solving which might enhance teaching and learning. This negligence and 'shy-away' attitude from problem-solving method of teaching might be an abstraction which makes the students less active and more prone to rote memorization as observed by Obiekwe (2008), in Nwagbo & Chukelu (2011).

Furthermore, Perveen (2010) reported that problem-solving sequence causes the learners to integrate the content conceptually in such a manner that the students can retain more readily than if the concepts were presented in an expository sequence. Given the preceding, the following problem solving phases was adopted for this study;

i. Presentation of the Problem: Students are presented with an open-ended problem for them to solve on the instructional content to be learned
ii. Defining the Problem: The second step consists of group discussions of what the problem is and which methods can be used to find the solution. The identified problem is then written down.
iii. Brainstorming: Another group discussion is held where the students use their prior knowledge to come up with ideas for different hypothesis to explain the problem. During this step all students are encouraged to speak their mind and all ideas are valued and noted.

iv. Structuring and Hypothesis: From steps two and three above different possible explanations of the problem are given eventually leading up to one final structured hypothesis which is written down in the hypothesis cause and effect.
v. Objectives: When the hypothesis is chosen and formulated the students must agree on achievable and comprehensible learning objectives for the task. These objectives will be the necessary knowledge the student needs to acquire before they will be able to continue on working with their hypothesis. These learning objectives are written down in the 'learning objectives'.
vi. Searching for Information: The search for information is done individually and with emphasis on mutual learning objectives. This will provide the student with more profound knowledge regarding the problem they are working on.
vii. Synthesis: During the final step the members of the group share the results of their individual findings, including structures, functions, and causes.
viii. Feedback: Feedback is given both from the students and the teacher regarding their individual and group process the organization of the task, and the teacher's guidance.

The study is of the opinion that the challenge facing the teaching of Basic Science subject is the poor teaching methodology employed by teachers, a visit to some of the schools have shown that Basic Science Teachers are still a custom with the Conventional method of teaching, it is in view of this, the researcher seeks to find out the effects of Problem-Solving methods on students' performance in Basic Science in junior secondary schools in Kaduna State, Nigeria.

Research Questions

This research provided answers to the following questions:

(i) What is the Pre-test and Post-test performance score of students taught Basic Science using Problem-Solving method?
(ii) What is the effect of Problem-Solving and Conventional Method on the academic performance of students in Basic Science in Junior Secondary Schools in Kaduna State, Nigeria?

Research Hypotheses

The following null hypotheses were formulated for the study and were tested at 0.05 significance level:

$H0_1$: There is no significant difference between the Pre-test and Post-test of those taught Basic Science using Problem-Solving method in Junior Secondary Schools in Kaduna State, Nigeria.
$H0_{2:}$ There is no significant difference between the performance of students taught Basic Science using Problem–Solving Method and those taught using Conventional Method in Junior Secondary Schools in Kaduna State, Nigeria.

Methodology

The study adopted quasi experimental research design. This is a pre-test and post-test experimental and control groups design. A non-randomized intact classes were used. The target Population of the study was made up of One hundred and nineteen thousand, two hundred and thirty eight (119,238) which comprised all the Junior Secondary School Two & Students in Kaduna State, Nigeria.

The study purposively sampled out the following schools: Government Junior Secondary School Television from Kaduna south educational zone, used as Experimental group 1;

Government Junior Secondary School Ungwan Rimi, from Kaduna North educational zone used as Experimental group 2; Government Junior Secondary School Rigachukun from Rigachukun educational zone was used as control group. The sample size for this study consisted intact classes of 146 Junior Secondary School Students. The sample size was arrived at using purposive sampling technique. The instrument used for data collection was an adopted test of multiple choices in Basic Science Junior Secondary Certificate Examination 2010-2014.

The content and face validation were done by experts in the field of education and the instrument was pilot tested using 30 students who are part of the population but not part of the sample for the study. The data was analysed using Pearson Product Moment Correlation Coefficient (PPMC) and a reliability coefficient of 0.79 was obtained, indicating that the instrument was suitable for the study. The statistical tools used for data analysis included descriptive statistics mainly Mean and Standard Deviation which was used to respond to the research questions raised in the study. The paired and independent t-test was used to test hypotheses at 0.05 level of Significance.

Data Presentation and Analysis

Research Question One: What is the Pre-test and Post-test performance of students taught Basic Science using Problem-Solving method.

Table1: Mean and Standard Deviation of Pre-test and Post-test performance of those taught using activity-based and problem-solving.

		Pre-test Scores		Post-test Scores	
Method	N	Mean	SD	Mean	SD
Problem solving	72	8.59	4.36	54.62	12.46

Table 1 shows the difference in performance of students before and after being taught using problem-solving method in Basic Science in Junior Secondary Schools, Kaduna State, Nigeria. The table indicates the mean score of 8.59 in the pre-test and 54.62 in the post-test and a standard deviation of 4.36 in the pre-test and 12.46 in the post test. Hence, the result indicates that the post-test performance of students taught basic science using problem-solving method was better than pre-test.

Table 2: Mean and Standard Deviation Scores of Students taught in schools Effect of Problem-Solving and Conventional Method

		Pre-test Scores		Mean	Post-test Scores		Mean
Method	N	Mean	SD	Diff.	Mean	SD	Diff.
Problem-Solving	72	8.59	4.36	1.62	54.62	12.46	4.58
Conventional	76	6.97	4.72		50.03	16.82	

Table 2 shows the mean scores as displayed on the table shows that students taught Basic Science using problem-solving had a better performance mean scores in pre-test and post-test. For instance, the students taught Basic Science using problem-solving had a post-test mean score of 54.62 with corresponding standard deviation of 12.46, while students taught using conventional method recorded post-test mean score of 50.03 with standard deviation 16.82. This shows that students' mean difference in post-test was 4.58. Therefore, the answer to question three was that the students taught using Problem-solving method had

better performance compared to those students taught using Conventional Method. This showed that both methods had positive effects on the performance of students. Although, problem solving method resulted in a better performance than the conventional method.

Hypotheses Testing

Hypothesis One: There is no significant difference between the pre-test and post-test performance scored of students taught Basic Science using problem-solving method. The data collected through the administration of the adopted test of multiple choice in Basic Science Junior Secondary Certificate Examination was analysed using paired sample t-test. The summary of data collected and analysed in respect of null hypothesis one is presented in Table 3

Table 3: Summary of pre-test and post-test paired sample t-test on the performance of students taught Basic Science using Problem–Solving Method

Method	N	Mean	SD	df	α	t-cal	t-crit	Sig. (2-tailed)	Decision
Pre-test	72	8.59	4.36	142	0.05	3.17	2.96	**.**002	Rejected
Post-test	72	54.62	12.46						

Table 3 shows the difference in pre-test and post-test performance of students taught Basic Science using Problem-Solving methods in Junior Secondary Schools in Kaduna State, Nigeria. The table shows the t(142) = 2.96, p=.00 (P<0.005). The null-hypothesis was thus rejected because there was significant difference in pre-test and post-test performance of students taught Basic Science using Problem-Solving methods in Junior Secondary Schools in Kaduna State, Nigeria. Hence, it was established that students that were taught Basic Science using problem–solving method had a higher score in their post-test result.

Hypothesis Two: There is no significant difference between the performance of students taught Basic Science using Problem–Solving Method and those taught using Conventional Method in Kaduna State, Nigeria.

The data collected through the administration of the adopted test of multiple choice in Basic Science Junior Secondary Certificate Examination (JSCE) was analysed using independent sample t-test. The summary of data collected and analysed in respect of null hypothesis three is presented in Table 4

Table 4: Summary of independent sample t-test on the performance of students taught Basic Science using Problem–Solving Method and those taught using Conventional Method

Method	N	Mean	SD	df	α	t-val	Sig. (2-tailed)	Decision
Problem–Solving	72	54.62	12.46	146	0.05	2.17	**.**002	Rejected
Conventional	76	50.03	16.82					

Table 4 showed that there was significant difference in the performance of students taught Basic Science using problem–solving method and those taught using conventional method in Kaduna State, Nigeria. The table showed t(164) = 2.17, p=.002 (P<0.005). The null-hypothesis was thus rejected because there was significant difference between the performance of students taught Basic Science using problem–solving method and those taught using conventional method in junior secondary schools in Kaduna State, Nigeria. Hence, it was established that students that were taught Basic Science using problem–solving method had a higher score and significantly performed better than their counterparts that were taught using conventional method.

Discussion

Findings on research question one and its corresponding hypothesis revealed that there was significant difference in pre-test and post-test performance of students taught Basic Science using Problem-Solving methods. The students taught Basic Science using Problem Solving method achieved higher post-test mean score than the pre-test. The result of the test on hypothesis one which stated that there was no significant difference between the pre-test and post-test performance between the students taught using problem-solving was rejected. The above findings strongly negate the findings of Gadzama (2012) that there was no significant difference in mean scores between students taught integrated science using activity-based and those taught using problem-solving method. The finding of the study agrees with Omeogun and Akani (2014) also buttressed that problem-solving approach (PSA) proved to be effective in improving students' learning outcome towards science.

Findings on research question Two revealed that the performance of students taught Basic Science using problem–solving method was higher and better than their counterparts taught using conventional method in Junior secondary schools in Kaduna State, Nigeria. The students taught Basic Science using problem–solving method achieved higher pre-test and post-test mean scores. However, the standard deviation at various levels indicated that students had varied performance in the test administered. Therefore, the result of the test on hypothesis three which stated that there was no significant difference between the performance of students taught Basic Science using problem–solving method and those taught using conventional method in junior secondary schools in Kaduna State, Nigeria was rejected. This finding was in agreement with the research findings of Perveen (2010), that problem-solving sequence causes the learner to integrate the content conceptually in such a manner that the students can retain more readily than if the concepts were presented in an expository sequence. This finding also supported the findings of Idris (2014) that students taught using problem-solving strategy achieved significantly better than those that were taught using lecture method; in terms of retention there was significant difference between students taught Basic Science using problem-solving teaching strategy than those taught using the lecture method. This finding also agrees with the findings of Adeniran (2013), that the students were exposed to the problem solving approach (PSA) performed significantly better than those exposed to the lecture method (LM).

Conclusion

Based on the findings of this study, the performance of students taught Basic Science using problem-solving method was higher and better than their counterparts taught using conventional method and this was as a result of students' involvement in solving the problem that was posed and deliberated upon in the process of finding out answers while learning was taking place, hence, led to better performance. However, conclusion was reached that the difference in the performance of students taught Kinetic theory of matter

and Thermal Energy using problem solving method was substantial than those taught using other and conventional methods.

Recommendations

Considering the findings from the study, the following recommendations were made as follows:

(i) Basic science teachers should be encouraged to use problem-solving methods because of its positive effect in enhancing students' academic performance.

(ii) The finding could encourage Curriculum planners and school managers to integrate problem-solving and activity-based method into classroom instructions and Government at all levels should incorporate and support the use of problem-solving methods in teaching Basic Science at junior secondary schools.

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