Innovations

Enhancing students' retention level of basic science curriculum concepts through problem solving instructional strategy

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Abstract
Enhancing students' retention level of basic science curriculum concepts through problem-solving instructional strategy was the study focus. The study adopted the quasi-experimental design. The study population comprised of nineteen thousand, two hundred and forty-nine (19,249) Basic 8 students from all the public secondary schools in Delta South Senatorial District of Delta State. A sample of two hundred and twenty (220) students were utilised. The classes were assigned using the random sampling technique. The research instrument was the Retention Basic Science Achievement Test (RBSAT). The reliability was established using Kuder- Richardson formula 21 which yielded a coefficient of 0.85.The acquired data was analyzed using descriptive statistics, and t-test at the significance level of 0.05. According to the study's results, students who were instructed basic science curriculum concepts using a problem-solving instructional strategy improved their retention tests than those who were instructed using a lecture method. There was no significant difference in mean retention scores between male and female students who were instructed basic science curriculum concepts using a problem-solving instructional strategy. Based on the conclusion, it was recommended among others that basic science teachers should be encouraged to adopt the problem-solving instructional strategy in teaching basic science curriculum concepts since it promotes retention of learned materials.

Keywords: 1.*Students' Retention Level****; 2.****Problem-Solving Instructional Strategy; 3.Retention; Basic Science Curriculum,4. Curriculum Concepts.*

Introduction

Education is the bedrock of civilization, an instrument of change, social progress and meaningful living. It is an indispensable tool for progress and sustainable development of any nation. Indeed, the survival of any development of any individual and the society in general depends largely on the type and quality of education the individual has been able to acquire. Every nation strives to provide quality education to better their citizen in order for them to effectively contribute to the social economic development of their nation. Hence the National Policy on

Education (2004) clearly defines Nigerian Philosophy of Education as being based on the integration of the individual into a sound and effective citizen. In order to effectively groom these citizens, learning contents and experience are selected into different subject matter that are taught at different levels of education.

Basic science is a core subject at the junior secondary level of education as specified in the National Policy on Education (2004). It is an introductory science course and a necessary background to all scientific and engineering careers. Basic science is described as a branch of knowledge that expresses the central idea of scientific integration via the use of ideas and principles. Basic science is a subject or course of study in which all scientific disciplines are interconnected and effectively collaborate. Mohammed et al (2008) defined Basic science as a course of study which is derived and presented in such a way that students gain the concept of the fundamental unity of science: the commonality approach to scientific issues and are assisted in gaining a knowledge of the roles and functions of science in daily life and the society in which they live.

Nigeria's basic science curriculum requires students to engage in inquiry and other activities that encourage critical thinking. This is evident in the objectives of basic science curriculum (NERDC, 2004) which include to enable students to:

a. Develop interest in science and technology
b. Acquire basic knowledge and skills in science and technology
c. Use your talents, technical knowledge, and abilities to satisfy society needs
d. Develop the skills necessary to pursue a career in science or technology
e. Prepare yourself for more science and technology studies.

The basic science curriculum is jam-packed with exercises and experiments designed to assist students better comprehend the theory while also providing ongoing practice in process skill development.

To achieve the aforementioned objectives, the use of problem solving instructional strategy becomes imperative in the sense that problem solving instructional strategy reduce obstruction, enhance lesson clarity, capture students attention and interests, promotes students active preparation and improve students ability to remember learning concepts.

Problem solving is the ability to identify and solve problems by applying appropriate skills systematically. It is a process and continuing action in which we use what we already know to learn what we don't know. It entails overcoming distractions via the generation of hypotheses, the testing of those predictions, and the development of suitable solutions. There are three fundamental activities involved in problem solving: gathering information, creating new knowledge, and making judgments. Problem-solving is and must be a significant component of the curriculum. As a crucial component of the curriculum, it is assumed that students may assume a portion of the responsibility for solving personal issues, resolving disputes, and discussing alternatives and styles of thinking. It gives students with opportunity to apply newly gained information in important real-life situations and supports them in working at higher thinking levels.

Problem-solving as an educational method entails tackling actual and recognizable problems. Using problem-solving as an intellectual method may help students build deep comprehension of fundamental topics and principles (Killer 2009). Problem-solving leads to active, deliberate learning. Students improve their reasoning, analysis, and objectivity. Problem-solving teaches students how to analyze a problem and the usefulness of their views.

Problem-solving a teaching or an instructional strategy has been shown in various studies to improve student's achievement (Adegoke 2017, Madina&Ochonogor, 2018). It does not only enhance student's achievement but also student's retention (El-Shaer& Gaber, 2014; Cheng, She & Huang, 2018). Retention is measured in collaboration with achievement. Hornby (2000) defined retention as the ability to remember experiences and things learnt. According to Nwanze (2016) retention is the ability of the student to recall what is taught after a given period of time. It encourages the ability of the student to apply knowledge from lessons in particular situations as a function of recall and conceptualization (Seifertt. 2012). The student retention is affected by a number of factors including instructional techniques, interest, student's activity during lesson, lesson assignment, exercises (Miles 2015).

Students' sex has been recognized as a predictor of their success and retention in sciencesubject, including basic science.Sex is the categorization of persons as male and female based on the outward appearance of sex

organs, often assigned at birth (Your Dictionary, 2018). However, the issue of sex influence on students' academic achievement and retention are inclusive (Ogheneakoke, Obro &Benike, 2019). Hence one of the study rationales is to find out if problem solving instructional strategy affects male and female students' achievement and retention differently in Basic science. Against this background, this study examined the enhancement of retention level of Basic science curriculum concepts among students through problem solving instructional strategy.

Statement of Problem

A review of student's performance/success in Basic Science subject in both internal and external examinations has remained consistently poor despite the relative importance of Basic Science as a fundamental subject to other science subjects. Some researchers have attributed the observed poor performance to students' difficulty to internalized basic science concepts. Others blamed the situation on the methods employed by the teachers which have been described as ineffective, teacher-centered, dull and uninteresting. This therefore calls for the need to explore other techniques which will promote effective retention of learned curriculum concepts as well as effective realization of the goals of science education in Nigeria. The problem which this study seeks to solve is: will the adoption of problem-solving instructional strategy enhance retention of basic science curriculum concepts among junior secondary school students?

Theoretical framework

The study was hinged on Ausubel's theory of learning (1968). The theory sees learning as a process of gaining knowledge through active participation and as such, for meaningful learning to take place, students should be able to relate new knowledge to what they had already known, construct meanings for concepts thus building their own knowledge structure. In Ausubel's theory of learning, a clear distinction is made between rote and meaningful learning; the students' prior and existing knowledge is more actively utilized to crate the new knowledge they are learning. This is contrary to the conventional way of teaching and learning where the students tend to be filled with the knowledge acquired by the teachers. Ausubel's theory of learning is related to problem solving instructional strategy because this teaching strategy encourage students to search for solutions to problem by relating new knowledge to what they already know

Research Questions

1. What is the mean retention scores of students instructed Basic science curriculum concepts using problem-solving instructional method and lecture method?
2. What is the mean retention scores of male and female students instructed Basic science curriculum concepts using problem-solving instructional method?

Hypotheses of the Study

1. There is no significant difference in the mean retention scores of students instructed Basic Science using problem-solving instructional strategy and those instructed using lecture method.
2. There is no significant difference between the mean retention scores of male and female students instructed Basic Science using problem-solving instructional strategy.

Methodology

The research used a quasi-experimental, non-randomized, pretest-posttest-control-group design. For the investigation, intact classes were randomly randomized to experimental and control groups, respectively. To prevent disruption of regular class times, the utilization of intact classes became required. Nineteen thousand two hundred forty-nine (19,249) junior secondary school 11 students from public secondary schools in the Delta South Senatorial District of Delta state make up the research population. Using basic random selection, a sample of two hundred and twenty (220) students was picked at random from four (4) public secondary schools.

The study instrument was the Retention Basic Science Achievement Test (RBSAT). The reliability was done using students from a school outside the sampled area for the study and coefficient of 0.85 was obtained. The instrument (RBSAT) was administered or given as a pretest, posttest and then as a follow-up test. The obtained or

gathered data were evaluated by using methods such as the mean, the standard deviation, and the t-test at a significance level of 0.05.

Results

R.Q. 1:

What is the mean retention score of students instructed Basic science curriculum concepts using problem-solving instructional method and lecture method?

Table 1: Descriptive Statistics of retention test scores of students instructed basic science with problem-solving instructional strategy and lecture method

Group	N	Retention test		Mean Difference
		Mean	SD	
Problem-solving	120	49.97	8.82	6.20
Lecture (control)	100	43.77	9.69	

Table 1 shows a retention mean score of 49.97, with a standard deviation of 8.82, for students instructed Basic Science with problem-solving instructional strategy, while students instructed Basic Science with the lecture method had a retention mean of 43.77, with a standard deviation of 9.69. The mean difference between both groups is 6.20, in favor of students instructed Basic Science with problem-solving instructional strategy.

Hypothesis 1

There is no significant difference in the mean retention scores of students instructed Basic Science using problem-solving instructional strategy and those instructed using lecture method.

Table 2: t-test comparison of retention test mean scores of students instructed basic science with problem-solving instructional strategy and lecture method

Group	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Problem-solving	120	49.97	8.82	221	4.999	0.000	$Ho_1$is rejected
Lecture (control)	100	43.77	9.69				

Table 2 shows that there is a significant difference in the mean retention test scores of students instructed Basic Science with problem-solving instructional strategy and those instructed with the lecture method, t = 4.999, P(0.000) < 0.05. Thus, the null hypothesis six is rejected. Therefore, significant difference exist in the retention scores of students instructed Basic Science with problem-solving instructional strategy and students instructed with the lecture method, in favour of students instructed Basic Science with problem-solving instructional strategy.

R. Q.: 2

Is there any difference between the mean retention scores of male and female students instructed Basic Science using problem-solving instructional strategy?

Table 3: Descriptive Statistics of retention test mean scores of male and female students instructed basic science with problem-solving instructional strategy

Sex	N	Retention test		Mean Difference
		Mean	SD	
Male	58	49.31	10.20	1.27
Female	62	50.58	7.35	

Table 3 shows a mean retention score of 49.31, for male instructed Basic Science with problem-solving instructional strategy, while their female counterparts instructed Basic Science with problem-solving instructional strategy had a mean retention score of 50.58. The mean difference between both sex is 1.27, in favour of female students.

Hypothesis 2

There is no significant difference between the mean retention scores of male and female students instructed Basic Science using problem-solving instructional strategy.

Table 4: t-test comparison of posttest mean retention scores of male and female students instructed basic science with problem-solving instructional strategy

Sex	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Male	58	49.31	10.20	118	0.787	0.433	Ho_7 is not rejected
Female	62	50.58	7.35				

Table 4 shows no significant difference in the retention scores of male and female students instructed Basic Science with problem-solving instructional strategy, t = 0.787, P(0.433) > 0.05. Thus, null hypothesis two is not rejected. Therefore, no significant difference existed between the retention scores of male and female students instructed Basic Science using problem-solving instructional strategy.

Discussion

According to the study findings, significant gap existed between the mean retention scores of students who were instructed basic science curriculum concepts using the lecture method and those who were instructed basic science curriculum concepts using the problem-solving instructional strategy. This gap was in favour of students who were instructed basic science curriculum concepts using the problem-solving instructional strategy. It's likely that this discovery has a number of potential explanations, one of which is premised on the fact that using a problem-solving instructional technique helps with the formation of deep, meaningful knowledge by stimulating critical thinking rather than simple memorizing. The teaching approach of problem-solving encourages students to explore information for themselves. Students who are being instructed in Fundamental Science using the problem-solving instructional technique are tasked with the responsibility of discovering information on their own. This enhances their capacity to recall information that they have acquired. This finding is in agreement with the views of Abubakar and Danjuma (2012) and Obro, Ogheneaokoke&Akpochafo (2021), who reported that problem-solving strategy improving both achievement and retention. This research also validates the conclusion reached by El-Shaer and Gaber (2014), who ascertained problem-based learning effect on students' critical thinking tendencies, as well as their information acquisition and retention. They established improvement in the total means score of knowledge acquisition and retention in the problem-based learning group in comparison to the total mean score in the lecture technique group for knowledge acquisition and retention.

Hypothesis 2 indicates no significant difference between male and female students instructed Basic Science topics using a problem-solving teaching style. Problem-solving teaching improves male and female science retention equally. Male and female students in the problem-solving instructional style group found information on

their own, which may explain the non-significant difference in female and male students' Basic Science retention scores. After four weeks, both sexes recalled Basic Science. This supports Ajai and Imoko's finding (2015). Ajai and Imoko (2015) explored gender inequalities in mathematics performance and retention. Ajai and Imoko (2015) found that male and female students instructed algebra utilizing problem-based learning had similar success and retention scores, indicating they can compete and collaborate in mathematics. This conclusion agrees with Zakiriya, Ibrahim, and Adisa (2016), who studied the effects of problem-based learning on math performance and retention in Sabon-Gari, Kaduna State. Zakiriya, Ibrahim, and Adisa (2016) found no difference in retention ratings between female and male problem-based learners.

Conclusion

The study proved that problem-solving instructional strategy facilitates students' retention than the lecture method. The reason for this was that learners exposed to problem-solving instructional strategy were able to use high cognitive level and critical thinking in recalling of facts and finding adequate solutions to problems. The study also confirms the enhancement of male and female retention level when instructed with the same learning conditions.

Recommendations

1. Problem-solving instructional strategy should be adopted in teaching curriculum concepts in basic science since it enhances students retention and achievement.
2. Curriculum planners and developers should incorporate and emphasize the use of problem-solving instructional strategy in the curricular at all levels in Nigeria.
3. In-service training, seminars, and conferences should be organized for teachers to acquaint them on the importance of problem-solving instructional strategy.
4. School administrators should provide adequate laboratory facilities to schools to enhance students' discovery of facts on their own.

References

1. *Abubakar, S. M., &Danjuma, I. M. (2012). Effects of explicit problem-solving strategy on students' achievement and retention in senior secondary schools physics. Journal of Science, Technology and Education, 1(1), 123-128.*
2. *Adegoke, B. A. (2017). Effect of explicit problem-solving instruction on secondary schools students' achievement in physics. International Journal of Scientific research in Education, 10(1), 87-101.*
3. *Ajai, J. T., &Imoko, I. I. (2015). Gender differences in mathematics achievement and retention scores: A case of problem-based learning method. International Journal of Research in Education and Science (IJRES), 1(1), 45- 50.*
4. *Ausubel, D. P. (1968). Educational psychology: A cognitive view,NewYork;Holt, Rineharl& Winston.*
5. *Cheng, S., She, H., & Huang, L. (2018). The Impact of problem-solving instruction on middle school students' physical science learning: interplays of knowledge, reasoning, and problem solving. Eurasia Journal of Mathematics, Science and Technology Education, 14(3), 731-743.*
6. *El-Shaer, A., & Gaber, H. (2014). Impact of problem-based learning on students' critical thinking dispositions, knowledge acquisition and retention. Journal of Education and Practice, 5(14), 74-84.*
7. *Folashade, A., &Akinbobola, A. O. (2009). Constructivist problem-based learning technique and the academic achievement of physics students with low ability level in Nigerian secondary schools. Eurasian J. Phys. Chem. Educ., 1(1), 45-51.*
8. *Mandina, S., &Ochonogor, C. (2018). Comparative effect of two problem-solving instructional strategies on students' achievement in stoichiometry. EURASIA Journal of mathematics, Science and Technology Education, 14(12), 1-9.*
9. *Miles, R. (2015). Tutorial instruction in science education. Cypriot Journal of Educational Science, 10(2), 168-179.*

10. *Nwanze, A. C. (2016). Effect of multimedia synchronized instructional strategy on students' achievement and retention in secondary school in Onitsha Education Zone. Unpublished M.Ed Dissertation Submitted to the Department of Science Education, Nnamdi Azikiwe University, Awka.*
11. *Omiko, A. (2016). An evaluation of classroom experiences of basic science teachers in secondaryschools in Ebonyi State of Nigeria. British Journal of Education, 4(1), 64-76.*
12. *Seifert, A. (2012). Absence of verbal recall or memory for symptom acquisition in fear and trauma exposure: A conceptual case for fear conditioning and learned non-use in assessment and treatment. Journal of Rehabilitation Research & Development, 49(8), 1209–1219.*
13. *Zakariya, Y. F., & Ibrahim, M. O., &Adisa, L. O. (2016). Impacts of problem-based learning on performance and retention in Mathematics among junior secondary school students in Sabon-Gari Area of Kaduna State. International Journal for Innovative Research in Multidisciplinary Field, 2(9), 42-47.*