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EFFECT OF PROBLEM-BASED LEARNING STRATEGY ON PUPILS' ACADEMIC PERFORMANCE IN BASIC SCIENCE IN ILORIN WEST LOCAL GOVERNMENT AREA OF KWARA STATE

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Abstract

This study investigates the effect of problem-based learning on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. The study adopted a pre-test, post-test control group, quasi-experimental design. Multistage sampling techniques were used to select the schools that participated. Schools were divided into two strata public and private using stratified random sampling technique. A simple random sampling technique was used to select four (4) primary schools, two public and two privates. These schools were randomly assigned to an experimental group and control group respectively. Five hypotheses were formulated. Pupils' Basic Science Performance Test (PBSPT) was used to obtained pupils score in Basic Science with a reliability coefficient of 0.74, and two treatment packages were used, Instructional Guide for Problem-Based Learning (IGPBL) and Instructional Guide for Conventional Method (IGCM). All the research hypotheses were tested using the Analysis of Covariance (ANCOVA) all at 0.05 level of significance. The

results of findings revealed among others that there was a significant effect of Problem-Based Learning on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State ($F_{(1; 86)} = 14.977, P < 0.05$). Based on these findings, it was concluded that there was a significant main effect of Problem -based learning on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. It was recommended among others that Training of teachers should be made compulsory and continuous by both public and private schools on different teaching strategies.

Keywords: Problem-Based Learning, Basic Science, Performance, Academic Performance

Introduction

Throughout the past few decades, numerous efforts have been made to enhance science education in various countries. A crucial aspect of this improvement lies in actively engaging learners, rather than passively absorbing information from teachers. In some schools, the traditional "chalk and talk" approach is still prevalent, where the teacher imparts abstract knowledge about science, leaving little room for hands-on experiences. However, it is essential to involve students in practical problem-solving or creative activities related to the subject matter. Failure to apply science in real-life situations within the students' environment could render the learning experience meaningless and challenging for them.

The most striking one is poor performance in science, especially in Basic science among primary school pupils, (Obomanu & Adaramola, 2011). Despite the importance of Basic Science to individual pupils and the society at large, as documented (Ochu & Haruna, 2015; Obomanu & Adaramola, 2011), students have been achieving poorly in the subject in Nigeria, especially Kwara State. According to Ochu and Haruna (2015), this poor academic performance in basic science by pupils has led many of them to the arts or social sciences due to insufficient prerequisite in science subjects. This creates a gap in national development. Basic science, also known as integrated science in secondary

school, is the first form of science a child encounters in school. This prepares students at the upper basic level for the study of core science subjects (Biology, Chemistry, and Physics) at the Senior Secondary (SS) level (Oludipe, 2012). This means that for a student to be able to study a single science subject at the SS level successfully, such a student has to be well grounded in Basic Science right from their primary school level. Unfortunately, there is an observable drastic and constant reduction in the level of achievement in science related subjects, which is applicable to students at all levels of education in Nigeria (Emaikwu, 2012; Ochu & Haruna, 2015). Research has revealed that this low performance in Basic Science among other things is because of poor or noninnovative methods of teaching (Obomanu & Adaramola, 2011; Ochu & Haruna, 2015).

It is as a result of the need for these changes in instructional methods to enhance learning that the researcher intends to recommend a departure from the conventional teaching method of teaching to one of the most recent constructivist-based teaching strategies known as problem-based Learning (PBL) strategy. Conventional teaching method is the method of teaching that is characterized by the following: it is teacher centered. It inhibits active participation of students in the classroom; it reduces students to mere note-taking and passive listeners and learners, perception and assimilation of the subject matter is slow. It is examination oriented. Many things can be factors responsible and pupils performance is closely linked to the effectiveness of teaching techniques employed by educators.

O'Connor (2012) identified the improper use of teaching techniques as one of the elements that contribute to the low participation and performance of pupils in science. The techniques used to teach are not practical enough, and teachers make little effort to relate the concepts learned and their examples or illustrations to real-life situations, especially in pupils' own lives and environments. This has a detrimental impact on

pupils' interest and motivation to study STEM fields, which consist of Science, Technology, Engineering, and Mathematics subjects. Teacher-centered methods in education emphasize the instructor's central role in the classroom, where teaching techniques employed often involve traditional lectures, direct instruction, and authoritative dissemination of knowledge to students.

Danso (2010) indicates that teachers favours teacher-centered, knowledge-based teaching techniques that don't give much space for learners' participation. Teachers expect pupils to understand basic science concepts without making the pupils involved in their learning by making use of “problem-based” learning activities that pupils can interact with to enliven the learning process and permanent. Valamis Group (2022) defined Collaborative learning as the educational approach of using groups to enhance learning through working together. Groups of at least two learners collaborate to solve problems, complete tasks, or learn new concepts. However, Collaborative learning and problem-based learning are interconnected approaches that emphasize active student engagement, group interactions, and the resolution of real-world challenges as fundamental components of the educational process.

KNILT (2011) asserted that when students take part in a problem–based learning (PBL) task, they utilize processes that allow them in order to show the mental and physical behaviours of scientists. In the process, they learn more than simple science concepts and skills. They learn a practical, useful real-world approach to solving problems and answering questions. The inquiry process involves the following steps. Observe a process or event, formulate questions based on observations, develop a workable hypothesis, devise a strategy for testing it analyze and draw conclusions from collected data, and review and evaluate conclusions. Communicate findings to others. As you may notice these steps are uncannily similar to the general steps of the scientific method.

Cindy (2004) stated that Problem-Based Learning (PBL) is an instructional method in

which students learn through facilitated problem-solving. Cornell University (2012) Problem-based learning (PBL) is a student-centered approach where and how pupils learn about a subject by working in groups to solve an open-ended problem. This problem is what drives motivation and learning. Nilson (2010) lists the following learning results that are related to Problem-Based Learning (PBL). A well-designed Problem-Based Learning (PBL) project presents students with the chance to develop skills related to working in teams, managing projects and holding leadership roles, oral and written communication, self-awareness and evaluation of group processes, working independently, critical thinking and analysis, explaining concepts, and self-directed learning, applying course content to real-world examples, researching and information literacy, and problem-solving across disciplines.

According to Indeed (2021), Problem-Based Learning (PBL) is a teaching method that allows a group of people to solve real-world issues through concepts and scenarios. This differs from how teachers or mentors usually teach students, which is by presenting facts for them to memorize. Rather, problem-based learning helps people to use critical thinking and problem-solving skills. Nations from around the globe (including Nigeria), try to educate their population in the fields of Science, Technology, Engineering, and Mathematics (STEM)s (Ndirika, 2012; Umar & Salihu, 2015; Enemarie, 2016; Nwachukwu, 2017 & Ajayi, 2017). The reason is not far-fetched; there are numerous contributions of using technology and science to human development. Nigeria a developing country, has made admirable efforts to improve the citizens' knowledge of science. Consequent to these efforts, Nigerian politicians and educators are aware of the importance of science and technology in achieving universal access to education and national development in the twenty-first century (Ogundele, Okunlola, Damilola & Godfrey, 2020). Instead of being accepted, it invites critical examination. Problem-Based Learning is an effective educational strategy that encourages students to apply their

knowledge and problem-solving skills to real-life scenarios, making it particularly valuable in teaching Basic Science concepts.

Basic Science is a critical subject for pupils to learn while they are in school because it plays such an essential role in everyday life and leads to many possible career choices. This has always been the case, but it is even more important in the high-tech age we live in. The world today demands pupils' at least a rudimentary knowledge of both the principles of science as well as how to apply them to solve real-life problems. However, teaching science in a way that allows pupils to learn the various aspects of the topic effectively is a real challenge for teachers. For pupils to learn science properly, they must be engaged both mentally and physically as much as possible in the tasks involved. That's where techniques such as hands-on and minds-on learning come into play (Nextstepu, 2021). However, several factors, such as teaching methods, school type, school location, gender, and numerous other variables, can contribute to low academic performance in Basic Science.

The specific type of school dictates what is taught, how it is taught, and what materials are available. Mari (2001) maintained that where educative materials are deprived, pupils suffer from academic deterioration and mental imbalance. Some studies by Sociologists, Psychologists, and Educationists showed that the type of school a learner attends has a great impact on his academic performance. Also, gender has a significant influence on pupils' academic performance. For instance, Mari (2001), found that learning outcomes through scientific means are more effective in promoting the acquisition of skills in females than in their male counterparts. Also, the findings of Mari (2001), revealed the existence of superiority in the performance of female pupils over their male counterparts in learning outcomes. Quiaiser-poul and Lehman (2002) opined that male pupil performed significantly better than their female counterparts in science. Erinosho (2005) states that science is a male enterprise, since it has not been discovered that

gender factor has a positive, negative, or no contribution to academic performance, it is, therefore, necessary in this study to find out if gender has any main effect on the academic performance of pupils in Basic science.

In a study conducted by Udo and Etiubon (2011) it was revealed that there was a significant difference in the mean achievement test scores of male and female students taught using the guided discovery strategy. Similarly, Ezinwa (2003) found that there was no significant interaction effect between guided discovery strategy and gender on students' achievement in quantitative analysis. In-line with this, Otite and Ogionwo (2006) found that male and female students from urban centres perform better in school work than their counterparts from rural areas due to the availability of socializing agents at the urban centres and the shortage of most of the facilities in the rural areas. Therefore, it is important to investigate whether there is a significant difference between male and female academic performance in Basic Science.

Statement of the Problem

Science education is the fundamental principle of any civilization and it's anticipated to result in people who can both solve their problems and that of their society. However, pupils are taught to memorize science and not given room to do science by interacting with learning resources. These have affected the performance of pupils in the subject, pupils do not only perform poorly but have very low interest in science, and pupils are expected to be confident, and independent after finishing school. Most recently, the relevance of what is taught in school to real-life situations is very low. Its evidence from 2020-2021 Common Entrance Examination, report revealed that majority of pupils' performance in science subjects in primary school is very low, this may be a result of methods used in teaching the pupils right from their primary school level and so many factors are responsible for this poor performance, of which lack of good teaching method

that involves pupils' active participation. It has been observed that many schools in Nigeria lack so many infrastructures especially problem-based activities resources for teaching.

However, it has been noted by several researchers, who carried out studies using different teaching strategies to teach Basic Science and other science-related subjects along with pupils' academic performance and despite this effort, the problem persisted. while few have studied the effectiveness of problem-based activity on pupils' social skills and in art subjects which may not have been examined in Basic Science as a subject and in Ilorin West Local Government Area of Kwara State. Hence, this justifies the need for this investigation. Consequently, this study examined the effect of problem-based learning on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

Research Hypotheses

To conduct this study, the following research hypotheses were postulated.

Ho1: There is no significant main effect of problem-based learning on pupils' academic performance in Basic Science.

Ho2: There is no significant interaction effect of treatment and gender on pupils' academic performance in Basic Science.

Ho3: There is no significant interaction effect of treatment and School type on pupils' academic performance in Basic Science.

Ho4: There is no significant interaction effect of treatment, gender, and school type on pupils' academic performance in Basic Science.

Methodology

The study adopted, pre-test, post-test, non-equivalent control group quasi-experimental design. The design is suitable for establishing a possible cause and effect relationship. A

factorial design of 2X2X2 was adopted to test the null hypotheses for this study. The first two levels are one experimental group (Problem-Based Learning) and one control group (conventional method). The second factorial level was based on gender, that is male (M) and female (F); while the third factorial level focused on school type (public and private). This design allows for the experimental group to receive treatment (Problem-Based Learning) while the control group never received any treatment, although the control group was taught the same topics as the experimental group using the conventional teaching method. However, the control and experimental groups took the pre-test and the post-test before and after treatment, respectively.

The study's population comprised all primary school pupils, both public and private in Ilorin West Local Government Area of Kwara State. Sample size for the study was four primary three classes. Multistage sampling techniques were used to select the schools that participated. Stratified random sampling techniques were adopted for the study to classify the schools into public and private groups. First, all schools were divided into two strata (public and private) and the simple random sampling technique was used to select four schools which included two private schools and two public schools. One public and one private school were used as experimental groups, and the remaining two schools were used as the control group (one public and one private school). The researcher used an intact class for the study, pupils in public schools were 53, while pupils in private schools were 42, with a total number of 95 participants. Basic Science Performance Test (PBSPT) with two treatment packages, Instructional Guide for Problem-Based Learning (IGPBL) and Instructional Guide for Conventional Method (IGCM), was used to elicit information from the participants. The data were analyzed using both descriptive and inferential statistics. The demographic data of the participants were analyzed using frequency counts, and percentage; while the research hypotheses were tested, using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Results

Test of Hypotheses

Five hypotheses were postulated in the study and tested with an Analysis of Covariance at a 0.05 level of significance.

Research Hypothesis One: There is no significant main effect of Problem -Based Learning on pupils' academic performance in Basic Science

Table 1: Summary of ANCOVA analysis showing the effect of Problem-Based Learning on pupils' academic performance in Basic Science.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	218.284[a]	8	27.286	3.350	.002
Intercept	600.395	1	600.395	73.715	*.000*
Pretest	23.967	1	23.967	2.943	.090
School-type	3.186	1	3.186	.391	.533
Gender	9.166	1	9.166	1.125	.292
Treatment	121.986	1	121.986	14.977	.000
School-type * Gender	.205	1	.205	.025	.874
School-type *Treatment	14.296	1	14.296	1.755	.189
Gender * Treatment	14.593	1	14.593	1.792	.184
School-type * Gender * Treatment	18.000	1	18.000	2.210	.141
Error	700.452	86	8.145		
Total	16844.000	95			
Corrected Total	918.737	94			

Table 1 shows the effect of Problem-Based Learning on pupils' academic performance in Basic Science. There was a significant effect of Problem-Based Learning on pupils' academic performance in Basic Science ($F_{(1; 86)} = 14.977$, $P < 0.05$). The hypothesis is therefore rejected in light of the result since the significant value (.000) is less than 0.05. This implies that Problem-Based Learning had a significant main effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. Table 1 reveals the sources of the difference in pupils' academic performance in Basic Science.

Research Hypothesis Two: There is no significant interaction effect of Problem-Based Learning and gender on pupils' academic performance in Basic Science.

Table 1 shows the interaction effect of Problem-Based Learning and gender on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. There was no significant interaction effect of Problem-Based Learning and gender on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State ($F_{(1;\ 86)} = 1.792$, $P > 0.05$). The hypothesis is therefore not rejected considering the result since the significant value (.184) is greater than 0.05. This implies that the interaction of Problem-Based Learning and gender has no significant effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

Research Hypothesis Three: There is no significant interaction effect of Problem-Based Learning and school type on pupils' academic performance in Basic Science.

Table 1 shows the interaction effect of Problem-Based Learning and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. There was no significant interaction effect of Problem-Based Learning and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State ($F_{(1;86)} = 1.755$, $P > 0.05$). The hypothesis is therefore not rejected considering the result since the significant value (.189) is greater than 0.05. This implies that the interaction of Problem-Based Learning and school type has no significant effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

Research Hypothesis Four: There is no significant interaction effect of gender and school type on pupils' academic performance in Basic Science.

Table 1 shows the interaction effect of gender and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

There was no significant interaction effect of gender and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State ($F_{(1; 86)} = .025$, $P > 0.05$). The hypothesis is therefore not rejected in light of the result since the significant value (.874) is greater than 0.05. This implies that the interaction of gender and school type has no significant effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

Research Hypothesis Five: There is no significant interaction effect of Problem-Based Learning, gender, and school type on pupils' academic performance in Basic Science.

Table 1 shows the interaction effect of Problem-Based Learning, gender, and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. There was no significant interaction effect of Problem-Based Learning, gender, and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. ($F_{(1; 86)} = 2.210$, $P > 0.05$). The hypothesis is therefore not rejected in light of the result since the significant value (.141) is greater than 0.05. This implies that the interaction of Problem-Based Learning, gender, and school type had no significant effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

Discussion of Findings

The finding emanated from this study, was that there was a significant effect of Problem-Based Learning on Pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. This implies that the pupils taught using Problem-Based Learning Method out performed their counterparts taught with the conventional method. This affirmed the finding of Abdu-Raheem (2012) which indicated that learners taught using problem-solving method had higher adjusted post-test achievement scores than those taught using conventional method. The possible explanation for the

similarity in the findings is that the two studies were conducted in Nigeria where a similar teaching method is applied across the country. This also corroborated the finding of Etokerem, Ibemenj and Alamina (2019) which revealed that learners exposed to problem-solving teaching obtained higher scores on achievement tests than those in conventional teaching methods. Other findings from this study showed that there was no significant effect of gender on Pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

There was no significant interaction effect of Problem-Based Learning and gender on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. This implies that Problem-Based Learning and gender had no significant effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

The findings from this study support the submission from Adeniyi and Fashina (2017) conducted a study on gender, socio-economic status, and self-concept as a determinant of senior secondary school student's academic performance in mathematics and science in Lagos State, where the descriptive survey research design was adopted in the study, the finding of the study revealed that there were no significant effects of gender on senior secondary school students in science and mathematics subjects.

This is in disagreement with the finding of Etokerem, Ibemenj and Alamina (2019) who reported that male learners taught using problem-solving methods recorded higher mean academic achievement scores than female students.

The study also revealed that there was no significant interaction effect of Problem-Based Learning and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. This implies that Problem-Based Learning and school type had no significant interaction effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. The findings

corroborate the findings of Alimi, Eniola, and Alabi (2012) who investigated the influence of school type and facilities on students' academic performance in Ondo State. Based on their findings, revealed no significant difference in the academic performance of students in the two types of schools. Also, Yusuf and Adigun (2010) examined the influence of school type, sex, and location on students' academic performance in Ekiti State secondary schools. Based on their findings, it was also revealed that school type had no significant effect on students' academic performance.

Contrary to the findings of the study, Newhouse, and Beegle (2005) evaluated the impact of school type on the academic achievement of junior secondary school students (Grades 7-9) using data from Indonesia. The primary data sources for the study were the three full rounds of the Indonesia family life survey (IFLSI, IFLS2, and IFLS3). The result revealed that students that attended public junior secondary schools, controlling for their characteristics, have higher test scores upon completion than those who attended private schools. The findings also negate the findings of Onekutu (2002) who examined the difference in the academic achievement of students in both private and public secondary schools in Akwa Ibom State. The findings showed that students in private secondary schools performed better than those in public schools.

The study revealed the interaction effect of Problem-Based Learning, gender, and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. There was no significant interaction effect of Problem-Based Learning, gender, and school type on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State. This implies that Problem -Based Learning, gender, and school type had no significant effect on pupils' academic performance in Basic Science in Ilorin West Local Government Area of Kwara State.

Conclusion

Based on the research Problem-Based Learning method can enhance higher and better performance in Basic Science than the conventional method of teaching and learning. The study concludes that Problem-Based Learning is an effective instructional method that can enhance pupils' academic performance and improve their problem-solving skills

Recommendations

Based on the result of this study, the following recommendations were made:

1. Basic Science Curriculum developers should make provision for and emphasize the use of Problem-Based Learning strategy by the curriculum implementers (teachers) because this method has enhanced pupils' academic performance in Basic Science.
2. Authors of Basic Science textbooks should include activities that will encourage the use of Problem-Based Learning strategy by the teachers and pupils.
3. Classroom teachers should be encouraged to use Problem-based learning method since it is effective for teaching Basic Science to primary school pupils.
4. Government and privately owned schools should be equipped with facilities to encourage the use of Problem-Based Learning strategy so that teachers can be educated with the use of such facilities to improve the teaching and learning process.
5. Training of teachers should be made compulsory and continuous by both public and private schools on different teaching strategies.

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