EFFECT OF PROBLEM-BASED TEACHING METHOD ON STUDENTS' ACADEMIC PERFORMANCE IN BASIC TECHNOLOGY IN UNIVERSITY DEMONSTRATION SECONDARY SCHOOLS, EDO STATE, NIGERIA

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Abstract

The provision of infrastructure, instructional facilities and employment of qualified teachers without the use of effective teaching methods may not enhance students' academic achievement in school subjects including Basic Technology. Therefore, this study investigated the effects of the Problem-Based Teaching Method (PBTM) on students' academic achievement in basic technology in University Demonstration Secondary Schools in Edo State. Three research questions guided the study and two null hypotheses were formulated and tested at the 0.05 level of significance. The quasi-experimental research design of non-randomized groups was the method used to carry out the study. The study had a population of 580 Basic 8 (JSS 2) students and a sample size of 70 Basic 8 students was purposively selected. Basic Technology Achievement Test (BTAT) was the instrument used for data collection. The instrument was validated by three experts and a reliability coefficient of 0.74 was established. The research questions were answered with mean ($\overline{X}$) statistics while the hypotheses were tested with Analysis of Covariance (ANCOVA). Findings revealed that students taught basic technology with problem-based teaching methods performed better in their post-test mean scores than those taught with the conventional teaching method. Also, findings indicated that the problem-based teaching method is more effective in enhancing the academic achievement of female students in basic technology. However, there was no statistically significant difference between the male and female students taught Basic Technology using PBTM based on their academic performance. It was recommended among others that basic technology teachers should use PBTM to teach their students since it is an effective teaching method.

Keywords: Problem-based teaching , Academic performance, Basic technology
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Introduction

Education is a major tool used to develop society through various training programmes offered at different levels of institutions. Such training is expected to equip the individuals to become better citizens who can contribute meaningfully to society. According to the Federal Republic of Nigeria, (FRN), in her National Policy on Education (2013), the goals of education are the development of appropriate skills, mental, physical and social abilities and competencies to empower the individual to live in and contribute positively to the society. The extent to which these goals are achieved is determined by students' achievement in examinations conducted by various examination bodies such as WAEC, NECO and NABTEB. In recent years, reports of secondary schools and technical colleges students performances in external examinations conducted by these bodies have not been encouraging. According to Aworanti (2013) the goals of technical education might not be achieved with the rate

of decline of students' achievement in science and technology related subjects including basic technology in external examinations, taken by secondary school students which are meant to assess their level of acquisition of knowledge, skills and attitude.

University Demonstration Secondary School (UDSS) is established by various universities to implement secondary school curriculum like other public secondary schools in Nigeria. It is part of the university community. It is established mainly for the children and wards of the university staff. However, the catchment area has expanded to children outside the university. University demonstration secondary school could be seen as a unit of the faculty of education in the sense that students of the faculty of education are expected to carry out their teaching practice exercise in UDSS.

University Demonstration Secondary Schools seems to have some advantages. The teachers and students are likely to have free access to the university's facilities such as sports facilities, laboratories and workshops. Also, the teachers are qualified with some having master's degree and PhD. Perhaps these and many more reasons account for the high academic standard of UDSS because of the available opportunity for in-service training. But recently, students' academic performances in some subjects including basic technology seems not to be improving despite the availability of instructional facilities. Academic records made available to the researchers revealed that between 2015-2019, less than 50% of the students who enrolled for the Basic Technology external examination passed at credit level and above.

Basic technology formerly known as introductory technology is one of the integrated vocational subjects in the curriculum objectives of upper basic schools in Nigeria. It is mainly designed to introduce junior secondary school students to the world of technology and engineering. Basic technology curriculum objectives which foster pre-vocational orientation in technology, basic technological literacy and creativity serve as a foundation on which the match towards the economic survival of an individual and nation can be built (Alade, 2011). Basic technology is one of the subjects that laid the foundation for vocational programmes that teaches how human beings can be useful and contribute positively to society. Uwameiye (1993) reported that through introductory technology, students are helped to explore the various areas of technology towards making intelligent career choices. Basic technology is a core subject compulsory for all the students at junior secondary school because it is a means of acquiring skills. The objectives of basic technology according to the Federal Republic of Nigeria, (2013) include:

to provide pre-vocational orientation for further training in technology;
to provide basic technology literacy for everyday living; and
to simulative creativity.

The curriculum content of basic technology is designed to achieve these stated objectives. It is an integration of subjects: technical drawing; metalwork technology, woodwork technology, automobile technology, building technology, and elements of agriculture technology, home economics and material science. Students are expected to acquire exploratory knowledge and skills in these subject areas listed if the right teaching method is applied.

The use of conventional teaching methods could be effective in handling large classes of students as in the case of public secondary schools in Edo State. But it might not be able to enhance students' learning in some subjects that is science and technology based. Such subject as basic technology is practically oriented which require that the students master the knowledge and skills for better performance in examinations.

The emphasis laid on the transfer of basic skills in basic technology has placed much demand on the selection and application of appropriate materials and the use of the proper methodology in teaching. Traditionally, teaching and learning of basic technology and other subjects in Nigerian schools are done in a structured way with emphasis on writing, reading and listening to teachers' talk. Howard and Armstrong (2010) however posited that teachers must diversify their instructional techniques if they are to successfully teach students of different abilities and learning preferences. Schools have therefore applied various approaches over the years in teaching students at various levels. It has been noted with dismay, however, that teachers including those in University Demonstration Secondary Schools (UDSS) are still using one or a combination of two or more conventional teaching methods such as lecture, discussion, demonstration to teach basic technology.

The use of this teacher-centred method sets the teacher as the only active participant in the class while the students are complete observed or 'admirers' throughout the lesson. This method encourages laziness, rote memorization which eventually kills their interest and attitude towards basic technology (Asogwa, 2011). Asogwa (2011) added that no strong emphasis was placed by teachers on the use of teaching aid. The basic technology teachers still regarded the way they were taught in their days as the best method to teach. Any systematic and effective lesson delivery must sustain students' interest and courage their active participation. However, Aja and Asadu (2012) observed that traditional methods, which are the demonstration, inquiry, discussion, project, lecture, and data collection method are used presently in public schools, to present basic technology content in such an abstract manner that most students seem to achieve little or nothing in the teaching-learning process. These methods which are not learner-centred consistently used by teachers without variation could likely be the causes of students' failure in basic technology examinations over the years.

Rather than using conventional teaching methods to teach basic technology, modern teaching methods which are student-centred could be used to enhance students' learning. An example of such a method is the Problem-based teaching method. The problem-Based Teaching Method (PBTM) is one of the student-centred teaching methods and it begins with the assumption that learning involves an active, integrated, and constructed process (Hal, 2001). It means that this method of teaching involves active participation and social interaction of students in the group such that individual students can construct knowledge and skills. That is, students must learn to be conscious of what information they already know about the problem, what information they need to know about the problem and the strategies to use to solve the problem. This process of learning will create in the students the skills that would make them become problem-solvers and learn independently.
The role of the teacher in this teaching method is to guide the students as they work in groups. The use of PBTM could be very effective for teaching basic technology since

it involves practical exercises in the workshop. Working in groups and sharing tools, and consumables could bring about the self-motivation of an individual group member and could also generate healthy competition among group members. However, PBTM has some disadvantages. According to Wood (2003), PBTM is resource-intensive, information overload and complex to evaluate. These shortcomings of PBTM may not be of any challenge in university demonstration secondary schools in Edo State.

In studying students' academic performance, gender cannot be ignored. In fact, the difference in academic performance due to gender is of paramount importance to the educationist. According to Lee (2001), gender is an ascribed attribute that socially differentiates feminine from the masculine. It connotes male and female or boys and girls in a given group of students. There is a general belief that boys are superior to girls in terms of cognition and logical reasoning as a result of certain factors and even superior in academic reasoning (Anigbogu, 2002). But Ojikutu (2005) disagrees with this claim. The author posited that difference in academic performance between male and female students does not exist. For instance, Okeke (2003) identified sex-role stereotype, masculine nature of science, female inability to withstand stress, as causes of differences in academic performance between male and female students. The influence of these factors seems to be more evident in sciences and science-related courses. In support of this fact, Njoku (1997) posited that sex role, stereotyping could be the origin of the difference in performance between males and females in technical and science education. Apart from investigating the effect of problem-based teaching methods on students academic performance in basic technology, this study is designed to also examine the influence of gender on the academic performance of secondary school students in basic technology when the PBTM is used as a teaching method.

Statement of the Problem

Improvement in technology has influenced all spheres of human lives and all sectors of the economy positively. Technology has made work easier and faster. In the educational sector, for example, technology is employed in the areas of teaching and learning, generating, keeping and retrieving information. But, many workers including teachers seem not to have the knowledge and skills for using the new technology and method for their daily work routine. It was observed that basic technology teachers are still using one or a combination of two or more conventional teaching methods to deliver their lessons. This teaching method that basic technology teachers are fond of using seems not to have courage students' participation in the teaching-learning process. Consequently, students are not likely to have mastery of the subject matter. This could result in poor academic achievement in basic technology.

Rather than using the conventional teaching method, PBTM could be used to enhance students' academic achievement in basic technology. This method is student-centred. It involves students' active participation in the teaching-learning process. This teaching method has been found by researchers to be effective in sciences and related subjects. What is not yet clear to the researcher is whether problem-based teaching methods could enhance students' academic achievement in basic technology in University Demonstration Secondary Schools in Edo State as it has been proven to be in other subjects. Therefore, the need to carry out this study.

Purpose of the Study

The main purpose of this study was to determine the effect of problem-based teaching methods on students' academic achievement in basic technology in University Demonstration Secondary Schools in Edo State. Specifically, the study determined the following:

the difference between the pre-test and post-test mean scores of students taught basic technology with problem-based teaching method;
the difference between the post-test mean scores of students taught basic technology with problem-based teaching method and those with conventional teaching method;
the difference between the post-test mean scores of male and female students taught basic technology with the problem-based teaching method.

Research Questions

The following research questions guided the study.

What is the difference in the pre-test and post-test mean scores of students taught basic technology with problem-based teaching methods?
What is the difference in the post-test mean scores of students taught basic technology with problem-based teaching methods and those taught with conventional teaching methods?
What is the difference in the post-test mean scores of male and female students taught basic technology with problem-based teaching methods?

Hypotheses

The following null hypotheses were tested at the 0.05 level of significance.

There is no significant difference between the post-test mean scores of students taught basic technology with problem-based teaching methods and those taught with the conventional teaching method.
There is no significant difference between the post-test mean scores of male and female students taught basic technology with the problem-based teaching method.

Significance of the Study

The findings of this study are of immense benefit to all students including basic technology students in Nigeria, basic technology teachers, government, curriculum planners, heads of schools and the society in general.

Through the active involvement of students in basic technology lessons, they could acquire relevant knowledge and skills that would prepare them for further studies in technology and related courses in future. Also, it would create awareness in the students of the world of technology.

Students' improvement in academic achievement in basic technology as a result of the use of problem-based teaching methods would serve as a motivating factor on the part

of the technology teachers. Therefore, the teachers will be encouraged to use problem-based teaching methods.

Students' academic improvement in basic technology is evidence that the resources committed to technology education by the government were judiciously utilized. This will encourage the government to be more committed to funding education.

Male and female students' academic improvement in basic technology as a result of the use of PBTM will inform the curriculum planners to incorporate problem-based teaching strategy into teachers' education programmes for effective programme delivery.

Continuous students' academic improvement could bring about an improved national economy in the sense that such improvement will produce graduates who are knowledgeable, skilled and committed to their jobs.

Scope of the Study

This study focused on the effect of problem-based teaching methods on students' academic achievement in basic technology in University Demonstration Secondary Schools in Edo State. The study was delimited to Basic 8 (JSS 2) students. It covered four basic technology topics, namely: Friction and effects; Ohm's law; Energy Conversion Process, and Belts and chain drive.

The variables considered were teaching methods (conventional and problem-based), students' academic achievement and gender.

Method

The research was carried out using the quasi-experimental design of pre-test, post-test non-randomized groups. It involved two groups: problem-based teaching and conventional teaching methods. According to Nworgu (2015), a quasi-experimental study does not allow for randomization of subjects to experimental and control groups. The regular Basic Technology teachers taught the two groups. They used the two separate lesson notes prepared by the researchers. This design was considered suitable for the study because there was no room for randomization. Intact classes were used to avoid disruption of normal class lessons.

The population of the study was all the 580 Basic 8 (JSS 2) students in the 2018/2019 academic session. This was the number of JSS 2 students that were in the two Universities Demonstration Secondary Schools (the University of Benin, Benin City and Ambrose Alli University, Ekpoma) as at the period of carrying out this study. The basic 9 (JSS 3) students could not be used because the school authorities did not allow it simply because they are the certificate class. The sample size for the study was 70 JSS 2 students in the two demonstration schools (UDSS Benin 40 students and UDSS Ekpoma 30 students). UDSS Benin had 24 male and 16 female students while UDSS Ekpoma had 18 male and 12 female students. JSS 2A students in Benin and JSS 2C students in Ekpoma were purposively selected because these two classes have the largest number of female students in each school.

The instrument used for data collection was Basic Technology Achievement Test (BTAT). The test contained 40 multiple choice test items with options A-D. The items were drawn from Basic Education Certificate Examination (BECE) conducted by National Examination Council (NECO). The instrument was validated by three experts. A pilot test was conducted in Delta State University, Abraka, Demonstration Secondary School. Kuder-Richardson formula 20 was used to calculate the reliability coefficient and it yielded 0.74.

Results

Research Question 1: What is the difference in the pre-test and post-test mean scores of students taught basic technology with problem-based teaching methods?

Table 1: Summary of pre-test and post-test achievement mean scores of UDSS students taught BT with the problem-based teaching method.

Treatment method	N	Pre-Test	Post-Test	Gained	Remark
		Mean score	Mean score	Mean	
*PBTM	40	33.77	69.85	35.08	Effective

*Problem-based Teaching Method

Table 1 indicates that the pre-test means scores of students taught basic technology with PBTM is 33.77 whereas the post-test mean score of the same group of students is 69.85. The gained mean is 35.08. Since the post-test mean score is greater than the pre-test mean score, it means that the problem-based teaching method is effective.

Research Question 2: What is the difference in the post-test mean scores of students taught basic technology with problem-based teaching methods and those taught with conventional teaching methods?

Table 2: Summary of pre-test and post-test achievement mean scores of UDSS students taught BT with problem-based teaching method and those taught with conventional teaching method

Treatment method	N	Pre-Test	Post-Test	Gained	Remark
		Mean score	Mean score	Mean	
*PBTM	40	36.44	70.64	34.20	Effective
**CTM	30	35.66	43.76	08.10	
Difference		00.78	26.88	26.10	

*Problem-based Teaching Method
** Conventional Teaching Method

Data presented in Table 2 depicts that the pre-test mean score of the group taught basic technology with problem-based teaching method and those taught with conventional teaching method are 36.44 and 35.66 respectively. Also, the post-test

mean scores of the problem-based teaching method group and conventional teaching method group are 70.74 and 43.76 respectively. The difference in the mean is 26.88 in favour of the group taught with the problem-based teaching method. This implies that the students taught with PBTM are 26.88 better than the students taught with CTM in terms of the post-test mean scores after treatment. Therefore, PBTM is effective.

Research Question 3: What is the difference in the post-test mean scores of male and female students taught basic technology with problem-based teaching methods?

Table 3: Summary of post-test achievement mean scores of male and female UDSS students taught BT with the problem-based teaching method.

Gender	N	Pre-Test Mean score	Post-Test Mean score	Gained Mean	Remark
Male	24	38.55	66.79	28.24	
Female	16	36.88	72.66	35.78	More effective
Difference		01.67	05.87	07.54	

The results presented in Table 3 shows that the pre-test mean scores of male and female students taught basic technology with problem-based teaching method are 38.55 and 36.88 respectively. Similarly, the post-test mean scores of male and female students taught basic technology with problem-based teaching methods are 66.79 and 72.66 respectively. The data in the table shows that the difference in the post-test mean scores between male and female students taught basic technology with problem-based teaching method is 05.87 and the difference in the gained mean is 07.54 in favour of the female students. This indicates that the problem-based teaching method is more effective in enhancing the academic achievement of female students in basic technology.

Hypothesis 1: There is no significant difference between the post-test mean scores of students taught basic technology with problem-based teaching method and those taught with the conventional teaching method

Table 4: Summary of ANCOVA of students' achievement mean scores in basic techniques taught with PBTM and those taught with CTM.

Source of Variance		Type III Sum of Squares	Df	Mean Square	F	P-value	Remark
Corrected Model		11255.578	2	5627.789			
Intercept		1958.904	1	1958.904			
Post-testRQ2		1011.417	1	244.969			
Group		7889.494	1	7889.494	268.202	.000	Rejected
Error		1220.778	37	18.599			
Total		91768.50	40				
Corrected	Total	12476.355	39				

Table 4 presents the summary of the ANCOVA results on the academic achievement of students taught basic technology with problem-based teaching methods and those taught with the conventional teaching method. The table reveals that at 0.05 level of

significance for 1df, the p-value is 0.00. Since the p-value is less than 0.05, the null hypothesis is rejected. Thus, there is a significant difference between the academic achievement of students taught basic technology with problem-based teaching methods and those taught with the conventional teaching method.

Hypothesis 2: There is no significant difference between the post-test mean scores of male and female students taught basic technology with the problem-based teaching method.

Table 5: Summary of ANCOVA of the academic achievement in the post-test mean scores of male and female students taught basic technology with the problem-based teaching method.

Source of Variance	Type III Sum of Squares	Df Square	Mean	F	P-value	Remark
Corrected Model	207.463	2	103.731			
Intercept	3005.705	1	3005.705			
Post-testRQ3	133.088	1	133.088			
Group	25.215	1	25.215	0.400	0.485	Accepted
Error	1231.205	37	58.629			
Total	90415.22	40				
Corrected Total	1438.666	39				

Table 5 reveals that at 0.05 level of significance, 1 df numerator and 39 df denominator, the calculated F is 0.400 with a P-value of 0.49 which is greater than 0.05. Therefore, the null hypothesis is accepted or retained. It means that the difference in the effect of problem-based teaching methods on the academic achievement of male and female students in basic technology is not significant.

Discussion of Results

Students taught basic technology with problem-based teaching methods improved academic achievement. The achievement mean score in the post-test was higher than the achievement mean score in the pre-test, that is before treatment. It means that the problem-based teaching method is effective in enhancing students' academic achievement in basic technology. This is in agreement with the findings of Eze, Ezenwafor and Obidile (2016) who reported that PBTM is an effective teaching method in enhancing students' academic achievements. This finding is in consonant with the report of Aja and Asadu (2002). The authors asserted that with the conventional teaching method that is presently used in public schools to teach basic technology abstractly that students hardly achieve in the teaching and learning processes.

The problem-based teaching method was found more effective in enhancing the academic achievement of female students in basic technology. However, the testing of the null hypothesis revealed that the difference between the academic achievement of male and female students in basic technology was not significant. This finding is in agreement with the report of Ojikutu (2003). The author reported that difference in academic performance between male and female students does not exist. Anigbogu

(2002) report disagreed with this finding. The author posited that boys are superior to girls in terms of cognition and academic reasoning as a result of certain factors.

Conclusion

Based on the findings of this study, it was concluded that the problem-based teaching method (PBTN) is effective in the teaching of basic technology. Therefore problem-based teaching methods could be used in the teaching and learning of basic technology to enhance students' performance, mastery of basic technical knowledge and skills.

Recommendations

From the findings of this study, the following recommendations were made:

Basic technology teachers in secondary school should use PBTM in teaching basic technology to enhance students' mastery and academic performance.
Basic technology students should be encouraged to use PBL in the learning of basic technology since it enhances academic performance.
University Demonstration Secondary School administrators should provide instructional facilities for using PBTM. Also, basic technology teachers should be given opportunities for in-service training to equip them with the skills required in the use of PBTM for teaching basic technology.
Curriculum planners should incorporate a strategy for using PBTM into teachers' education curriculum. This will equip basic technology teachers with the competencies needed for using PBTM effectively.

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