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Research Article

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Effect of just-in-time teaching strategy on academic performances of students in physics

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ABSTRACT

The study examined how "Just-in-Time-Teaching" (JiTT) affected physics students' academic performance in Ondo State, Nigeria. Two hypotheses were examined while the study was driven by two research questions. The study used pretest - posttest control group research design. 100 pupils were adopted for this study. Two secondary schools from the local government region were chosen at random, with one serving as the experimental group and the other as the control group. The study's target population was SS I students taking Physics in the identified schools. JiTT was used employed to for the experimental group while the control group was given the same information in a normal classroom situation. The Just-in-Time Physics Achievement Test (JiTTPAT), which comprises 20 multiple-choice questions was developed by the researchers on the topic of measurement of physical quantities, was used to gather data with reliability index of 0.76. Mean, standard deviation, and ANCOVA were used to analyze the data with the aid of SPSS. The study came to several conclusion, including the following: JiTT improves student achievement grades in Physics, and gender had no significant effect on students' performance in physics. According to the results, it was suggested, among other things, that JiTT be implemented in secondary schools to enhance and improve students' achievement grades in Physics.

Introduction

Physics is one of the important branches of science that has contributed to the globalization of the world in terms of providing scientific knowledge in advancement in technology in area of medicine, crime control, invention of modern electronics gadgets such as high-power microscopes, application and utilization of integrated circuit, information communication and technology (ICT), rocket and satellites, refineries and mechanization of agricultural produce are derived from the principle of physics. As a result, the contribution of physics to the invention of science and technology in the in world cannot be undermined. Akano (2004) noted that physics is the foundation of modern technology, industrialization, and civilization. The lighting system,

cooking system, heating system, and other necessities of daily life are examples of how physics has impacted technology.

The current science curricula have been revised repeatedly in different states and given extensive standards in accordance with the complex needs of changing human existence, scientific advancement, and knowledge augmentation. It is believed that traditional instructional strategies alone are unable to meet these evolving expectations. Akinbobola and Bada (2017) asserted that the updated physics curriculum was changed to accommodate students' dynamic needs and desire to be globally competitive. It offers a brand-new platform where secondary school students can get useful technical, vocational, and entrepreneurship skills in preparation for further education and the workforce. Therefore, the main goal of scientific instruction in schools is to promote students' knowledge of the topic being taught with a view to applying it to real-world situations as well as to facilitate their development of science process skills (Afolabi and Akinbobola, 2012).The inclusion of "Physics in Technology" in the new physics curriculum in view of modern scientific and technological advancement of the changing world is to get the learners informed and familiar about the happenings in the world and prepare their minds towards meeting the societal needs through science and technology.

Just-in-time as a teaching method was developed for university level physics instructors. The pedagogical strategy was initially used in an introductory physics course in the late 1990s to meet the demands of non-traditional students in the United States. A paradigm shift in higher education was occurring at that time, and professors started to question the value of the conventional classroom mode of teaching as the accepted pedagogical strategy (Johnson et al., 1991 and Novak et al., 1999). The JiTT developers' method, which assumes that all students enter class with some existing knowledge and build on it to gain more, is based on constructivist theory. Additionally, research in the field of education has unequivocally shown that students are more motivated and learn more in classes in which they actively participate as compared to passively (Halpern & Hakel, 2003). The idea behind JiTT was to develop a teaching method that would excite students both in and outside of class and pique their interest in the subject matter being covered. Additionally, since Web-based technology was now widely accessible, the creators took advantage of it to stimulate and enhance student-teacher engagement outside the classroom. The feedback gives teachers firsthand information about students' current performance, area of difficulty, and unresolved issues. The operations of JiTT technique start with a pre-class activity that is conducted online (thus the name "JiTT"). Most times, it come in form of a few short-answer questions that focus on key ideas are included in the JiTT activity. According to Marrs and Novak (2004), the two most crucial JiTT exercise kinds are called 'warm-ups' (which is intended to serve as entry knowledge in introducing the new lessons and later generate class discussion or debate) and puzzles (which will then integrate the concepts taught and then and assess the student after working with class materials). However, JiTT questions come with varied styles depending on the subject and the target topic. It's important to keep in mind that the JiTT method of instruction was tested using the discipline of physics, but the students examined were located outside of the country where most of their institutions have better electronic, e-learning facilities and well-stocked e-libraries with pertinent contemporary technology.

Several academic discussions have centered on the effects of teaching strategies of academic performance of students in Physics. Atsuwe (2017) who conducted research on the effect on action learning strategy in Physics under the concept of fluid mechanism reported that student taught with action learning strategy perform better that those students taught with traditional method of teaching. Akinbobola (2009) in his research on learning strategies also found out that cooperative learning strategy which is based on small group interaction among learners to

achieve a purpose enhances students' performance and attitude to Physics than competitive and individualistic strategies that is self-centered. Studies carried out by Ikitde and Bassey (2013) and Akinbobola (2015) showed numerous conclusions regarding teaching and learning strategies. It was opined that teaching strategy is a factor that influences group discussion, some observed that there is a relationship between student perceived classroom environment and instructor's teaching style by components of personality type. In her recent work, Ibe (2016) discovered that guided discovery strategy drastically enhanced students' performance in senior secondary schools than expository method.

Furthermore, the place of gender in performance of students in sciences especially in Physics and Mathematics has gained more attention among researchers. Okebukola (2002), Longe and Adedeji (2013), Yoloye (2004) and Ezirim (2006) quoted in Ponle (2011), are of the opinion that science and technology is a male dominated subject, and that female tends to shy away from scientific and technological fields. Afolabi and Akinbobola (2012), showed that, gender has no significant effect on students' performance in Physics using action learning and problem- based strategies while Atsuwe & Amed (2016) reported that gender is significant in the achievement grade in Physics.

The preceding scenario leaves an apparent gap in a search of a teaching strategy that is not gender biased. Therefore, the purpose of the study is to assess the effects of JiTT method of teaching with regular classroom method also called lecture method on the cognitive gain of students studying Physics and the effect of gender in students' achievement grades in Physics.

Research questions

The study provided answers to the following research questions:

1. How much do students who are taught physics using the JiTT technique and those who are taught identical subjects using the lecture approach differ in their academic performance?
2. To what extent does gender affect students' physics achievement grade?

Research hypotheses

The following are the research hypotheses tested in the study:

$H_0$1: There is no significant effect of teaching methods on performance of students in physics.

$H_0$2: There is no significant effect of gender on the achievement grades of students taught in physics using JiTT.

Method

Research design

The pretest-posttest control group research design was chosen for the study. Two secondary schools from the area of study were chosen at random, with one serving as the experimental group and the other as the control group. Before the start of treatment, the experimental and control groups received a test (pre-test) to gauge the students' entry knowledge. After that, students in the experimental group were taught the concept of Measurement of Physical quantities using JiTT method of teaching while students in the control group were taught the same concept using the conventional (lecture) method of teaching. After periods of engagements with both groups, both groups were again subjected to another test (post-test) using the same test instrument which has been rearranged and properly shuffled.

Participants

All the physics students in Ondo West Local Government Area, Ondo State, made up the population of the study. 100 students made up the study's sample, with 62 female and 38 male pupils. The study's participants were specifically picked among SS I students taking Physics at the chosen schools.

Data collection tool

JiTT Physics Achievement Test (JiTTPAT) served as the main research instrument. The developed consists of 20-item multiple-choice questions which was created based on the Physics SS 1 work plan under the concept of measurement of physical quantities. The reliability index of the JiTTPAT was found to be 0.76 using Kuder-Richardson formula-21. The researcher utilized this both for the pre-test and post-test. Based on the relative importance of each concept in the curriculum, a test blueprint was created.

Data analysis

The scores of students from the JiTTPAT serve as the data used for the analysis. Both pre-test and post-test scores were recorded according to group and according to gender. Mean, standard and deviation of the students' cognitive achievement in JITTPA were used to answer the research questions and ANCOVA was used to test the hypotheses at 5% confidence level. The data collected were analyzed with the help of SPSS. The research variables and some other factors involved in the study were taken into consideration before choosing the statistical tools. ANCOVA analysis on pre-test scores for subjects in the experimental and control groups was used to establish that the two groups were equivalent before treatment began.

Findings

Research questions and hypotheses

To answer the research questions, mean and standard deviation of students' scores in the JiTTPAT were employed (Tables 1 and 2), and ANCOVA was used to test the hypotheses (Table 3) at 5% confidence level.

Research question one

How much do students who are taught physics using the JiTT technique and those who are taught identical subjects using the lecture approach differ in their academic performance?

Table 1 Pre-test and post-test mean and standard deviation of treatment and control group.

Group	N	Pre-test Mean	SD	Post-test Mean	SD	Mean Gain	Remark
Experimental	50	8.76	2.73	15.20	1.93	6.60	Positive Effect
Control	50	6.58	1.74	11.42	2.29	4.84	

Table 1 shows the results of the pretest and posttest of both the experimental and control group. The students treated with the JiTT method had pre-test mean scores of 8.76 and post-test mean scores of 15.20 with mean gains of 6.60 while the students in the control group, had pretest mean scores of 6.58 and posttest mean scores of 11.42 with mean gains of 4.84. This has a positive effect on the side of the students that received treatment. To test the significance of this effect, the null hypothesis generated from the research question one was tested.

Ho1: There is no significant effect of teaching methods on the performance of students in physics.

Table 3 shows one-way ANCOVA test performed on the effects of teaching methods on students' achievement grades in Physics. The independent variables are treatment and gender. The post-

test scores of the students served as the dependent variable, and the pretest scores served as the covariate. The results of the analysis indicate that this hypothesis should be rejected, F(1, 95)=52.05, p<.05.

Research question two

To what extent does gender affect students' physics achievement grade?

Table 2 Pretest and posttest mean and standard deviation of male and female students.

Group	N	Pre-test Mean	SD	Post-test Mean	SD	Mean Gain	Remark
Experimental	38	8.53	2.58	14.47	2.59	5.94	Positive Effect
Control	62	7.15	2.37	12.60	2.76	5.45	

Table 2 shows the pretest and posttest scores of male and female students in both groups. The male students had pretest mean score of 8.53 and posttest mean score of 14.47 with a mean gain of 5.94. The table also included the female students' pretest mean score of 7.15 and posttest mean score of 12.60, with a mean gain of 5.45. The difference between the groups mean gains is 0.49. This suggests that the students' gender has very little favorable effect on their academic success in Physics. To test the significance of this effect, the null hypothesis generated from the research question two was tested.

Ho2: There is no significant influence of gender on the achievement grades of students taught in physics using JITT.

Table 3 further the results of the effects of gender on students' achievement grades in Physics. It was observed that at 5% level of significance, the identified source of variation he identified source of variation titled 'gender' Ho is thereby accepted F (1, 95) = 0.38, p > 0.05. Therefore, there is no significant influence of gender on the students' mean achievement scores in Physics among students using JiTT method and those taught using convectional lecture method.

Table 3 The Analysis of Covariance (ANCOVA) of students' achievement grades in physics with JITT treatment

Source of variation	SS	df	MS	Fcal	p-value	Decision
Corrected Model	364.050[a]	4	91.013	20.06	.000	**S***
Intercept	1370.424	1	1370.424	301.83	.000	**S***
Pretest	4.323	1	4.323	.95	.332	**NS**
Treatment	236.337	1	236.337	52.05	.000	**S***
Gender	1.723	1	1.723	.38	.539	**NS**
Treatment *Gender	.606	1	.606	.13	.716	**NS**
Error	431.340	95	4.540			
Total	18511.000	100				
Corrected Total	795.390	99				

R Squared =.458 (Adjusted R = .435)
Computed using alpha = .05
Decision:
S*= p < .05
NS= p > .05
SS= Sum of Squares
M= Mean Squares

Results and discussion

The effect of JiTT treatment on students' achievement grades in physics

The effects of JiTT on students' achievement grades form the pivot of this study. The findings in Table 1 demonstrate that students who received JiTT treatment achieved higher grades compare to those who were taught the same course with a conventional approach. In concrete terms, the experimental group's mean increase was 6.60 compared to the control group's mean gain of 4.84. This demonstrates a difference of 1.76 in their means in the favour of the experimental group.

This result indicates that using the JiTT instructional technique improves students' academic achievement. Since the JiTT has been shown to improve students' performance in Physics more than the traditional technique, it is obvious that when balancing the two teaching approaches, learning experiences in the classroom should be planned. This could be attributed to the fact that, JiTT method is more student-centered than the convectional method. This finding is consistent with those of Ibe (2013) and Enwere (2016), who found that JiTT greatly improved students' performance in business studies in secondary schools. This result is consistent with Gavrin's (2006) discovery that JiTT was substituted with the lecture approach, which significantly improved students' performance in Physics. It is also in agreement with the studies of Briz and Mclaughlin (2008), Naboth (2014) who found an improved grades in students' performances when JiTT was employed to teach mathematics and financial accounting respectively. JiTT strategy may have resulted in better student performance than convectional because small-group work, active and participatory work (asking questions, encouraging social interaction, exhibiting self-management etc.) enhance better academic performance. Synchronous activities are also embedded in JiTT. Synchronous communications include in-person conversations just like a virtual classroom or meeting.

Gender influence on students' achievement grades in physics

Results in Table 3 demonstrate that gender has no discernible impact on students' academic performance in Physics. Nevertheless, the findings in table 2, male students gained an average of 5.94 points compared to female students' 5.45 points. This results in a mean difference of 0.49 in the favour of the experimental group. The data in Table 3 support this conclusion, as shown by the observed probability value of 0.539 in Table 3, which is not significant at the 0.05 level of confidence. This finding is not in agreement with the earlier work by Atsuwe and Amed (2016), Ponle (2011) who revealed that gender has significant influence on achievement grades of students in Physics. Therefore, it can be concluded that gender has no effect on students' achievement grade in Physics, students can therefore do gallantly in the field of technology regardless of gender. This is evident today; many women are now undertaking most crucial position in industries, as science researchers and top position in academics in our country. Large percentage of females are being enrolled into Engineering courses, technology, applied Physics in Universities and Physics education in faculty of education in a university. It is worth knowing that a good teaching strategy under normal condition supposes not be gender biased; male and female should have equal capability to gain maximally irrespective of such discipline.

Conclusion

The lecture technique, which is widely used in schools to teach physics, is unproductive since it does not raise student achievement grades or encourage deep understanding of concept being taught. JiTT is a potent innovation that can improve student achievement levels in physics teaching and learning. It means that the implementation of this relatively new style of education

is not hindered by environmental circumstances, whether they are developed or not. As a result, it is highly advised for training in physics and other sciences at all educational levels.

From the foregoing discuss, the following conclusions were drawn from the study:

i. This study established how teaching strategies affect students' performances and interest in Physics.
ii. No significant effect of gender on students' performances in Physics.
iii. There is need for JiTT learning strategy to be adopted in teaching concepts.

Recommendations

In view of the implication of the results from this study, it is thereby recommended that:

1. JiTT should be enacted into the Physics and science curriculum as an effective teaching strategy.
2. Adequate facilities, both manual and electronic should be provided in the library by the government to give students access to electronic database to fully utilize JiTT in teaching and learning processes.
3. Conferences, workshops, and seminars should be organized for teachers on the use of JiTT method to make it popular among the teachers.
4. Without regard to sex difference, physics teachers should make implement JiTT teaching strategy in the classroom for better performance of students' grades.
5. Government, Ministry of Education, Proprietors, and school heads of faculty should reward teachers who through effective use of JiTT learning strategy achieve results.

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Disclosure statement

No potential conflict of interest was reported by the author(s). The authors hereby declare that there are not any competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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