APPRAISAL OF SECONDARY SCHOOL PHYSICS STUDENTS' ATTITUDE TOWARDS THE THREE MODES OF FLIPPED CLASSROOM COLLABORATIVE LEARNING STRATEGIES IN MINNA, NIGERIA

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Abstract

The study appraised senior secondary school Physics students' attitude towards the three modes of flipped classroom collaborative learning strategies in Minna, Nigeria. The study adopted quasi-experimental research design. A research question and a corresponding hypothesis were formulated and tested at 0.05 alpha level. One hundred and forty-six students from intact Physics classes were randomly selected as the sample of the study constituting of 67 male and 79 female students from four Senior Secondary Schools in Minna. Each of these schools was randomly selected as experimental group I, group II, group III and the fourth for the control group respectively. Experts validated Flipped Classroom Instructional Package and Students' Attitude towards Flipped Classroom Questionnaire (SATFCQ) which were used as the treatment and data collection instrument. A reliability coefficient of 0.81 was obtained from the pilot testing of the SATFCQ using Cronbach Alpha. ANOVA was used for testing the hypothesis at 0.05 level of significance. The results showed that: Physics students taught using the three modes of flipped classroom in collaborative learning setting (TPS, RT and TAPPS) and those in individualized learning setting (IL) had right attitude towards the developed Flipped Instructional Package. It is recommended among other, that educational policy makers should organize seminars and workshops on blended learning for teachers on the use of modern innovative methods of teaching and learning. Flipped classroom collaborative and individualized learning strategies should be incorporated into the school curriculum plan processes.
Keywords: Flipped Classroom; Flipped Instructional Package; Collaborative Learning; Attitude; Physics

Introduction

In embracing and integrating technology into the classroom, students are being prepared for successful life outside the school as this helps to build collaboration, interaction, and teamwork. Students of today have been referred to as digital natives or millennial students in that they grow up using technology at early stage than other students in previous generations. These students learn differently than those before them because the technology they use has become a way of life for them (Roehl et al., 2013). They have information at hand through the internet and they can ultimately connect with others around the world.

Hence, for national development in technology, basic concepts and principles of Physics are indispensable. Gambari and Yusuf (2017) explained that Physics education is aimed at training students to acquire appropriate scientific skills and attitudes as a prerequisite for future scientific activities. To achieve this objective, active participation and collaborative learning activities become imperative and there is need for functional instructional media to make physics instruction effective. The teaching of Physics in secondary school is aimed at producing young scientist who would be able to design the technological devices that would make everyday activities easier and life more comfortable (Ajayi, 2008). Since Physics is one of the pivotal subjects in technology and national development, the teaching and learning of Physics require serious attention to enhance a sustainable technological development in Nigeria and Niger state in particular. In fact, companies, hospitals, maintenance outfits, oil and gas industries, and many others employ artisans; attendants and technicians have at least a pass in physics. Even on grounds of direct personal benefits, a basic knowledge of physics enables one to rectify minor fault in home appliances, personal computers, and private cars, among others (Mbamara & Eya, 2015). In general, the level of development of a country like Nigeria is dependent on

the extent of its acquisition and utilization of innovations. This is unattainable if a working knowledge of physics does not exist.

Despite the numerous benefits of Physics, more attention needs to be given to the teaching of Physics especially at the secondary school level. Presently, research findings revealed that students' performance in the subject has been very low in both internal and external examinations in Nigeria (Aiyelabegan, 2003; Akanbi, 2003; Kola, 2007 & Bello, 2012).

Also, Akanbi (2010) observed that the trend in the performance of secondary school students in science subjects, especially Physics assumed threatening and frightening dimension. One of the factors responsible for poor performance in Physics is the abstract nature of the subject (Adeyemo, 2010). This implies that the mastery of Physics concepts might not be fully achieved without the use of instructional media or innovative teaching strategies. The teaching of Physics without instructional materials or appropriate teaching strategies may certainly result in poor academic achievement (Onasanya & Omosewo, 2011). The authors also stressed that, no matter how well trained a professionally qualified science teacher may be, he/she would not be able to put in ideas into practice if the school lacks equipment and instructional resources to translate his/her competence into reality. Furthermore, Okoronka and Wada (2014) identified poor teaching strategies and methods among which is traditional approach as a major factor contributing to poor performance in Physics.

Also, another factor which low academic performance has been attributed to is gender bias in Physics and Mathematics (Agommuoh & Nzewi, 2003). The author posited that some courses like physical sciences and technical courses which are dominated by male students were regarded as difficult for female students while biological sciences, Home Economics and Secretarial Studies which were dominated by female students were regarded as simple courses. This traditional way of classifying students had also affected their learning and performance the same way traditional method of teaching had done. In the traditional teaching method (teacher-centered), students attend class, take note, and prepare for exams; they do not have personal input in their learning.

The traditional methods of teaching have primarily revolved around a teacher-centered approach where instructors focus on conveying information, assigning work, and leaving it to the students to master the material. This type of instruction forces students to be merely receptors of information rather than participants in their own learning processes through active learning. To overcome these problems, there is need for paradigm shift from traditional methods of teaching to innovative teaching strategies using modern technological devices. Fortunately, technology has increasingly grown and infiltrated the classrooms, especially in developed countries; new learning models have emerged that move away from the teacher-centered approach to a more collaborative (student-centered) learning environment. These include mobile learning, collaborative learning, web-based learning, flipped classroom, among others (UNESCO, 2016).

Flipped classroom is an instructional strategy and a type of blended learning that reverses or inverses the traditional learning environment by delivering instructional content outside the classroom. It moves activities, including those that may have traditionally been considered homework into the classroom. In a flipped classroom, students watch online or offline lectures, collaborate in online discussions, or carry out research at home and engage in concepts in the classroom with the guidance of a mentor. Also, content delivery in a flipped classroom may take a variety of forms. Often, video lessons prepared by the teacher, or third parties are used to deliver content (Abeysekera et al., 2015).

Flipped classroom instruction (Flipped Learning Network, FLN, 2014), is a pedagogical approach in which direct instruction moves from the group learning to the individual learning, and the group learning is subsequently transformed into a dynamic, interactive, learning environment. The role of teacher is to guide students as they apply concepts and engage creatively in the subject matter. In practice, activities can take many forms, but generally involve students preparing for class by watching a pre-recorded lecture or undertaking assigned reading and activities, followed by the 'lecture' time being used for interactive discussion, problem-solving and other activities with the teacher. As such, the role of the teacher shifts from being the 'sage on the stage' to the 'guide on the side' (FLN, 2014).

The main goal of a flipped classroom is to enhance student learning and achievement by reversing the traditional model of a classroom, focusing class time on student understanding rather than on lecture (Wilson, 2013). To

accomplish this, teachers post short video lectures online for students to view at home prior to the next class session. This allows class time to be devoted to expanding on and mastering the material through collaborative learning exercises, projects, and discussions. The benefits of this approach include: an increase in interaction between students and teachers, a shift in the responsibility for learning on to students and opportunity for students to prepare at a time that suits them. It also provides an archive of teaching resources; an increase in student engagement and a shift from passive listening to active learning collaborative working between students, (Bergman, et al., 2011).

Collaborative Learning (CL) strategy is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product (Roberts, 2009). Collaborative learning is an umbrella term for a variety of approaches in education that involve joint intellectual effort by students or students and teachers. It can also be defined as a strategy and learning environment in which learners engage in a common task in which everyone depends on and is accountable to each other. It involves use of small groups so that all students can maximize their learning and that of their peers. It is a process of shared creation: two or more individuals interacting to create a shared understanding of a concept, discipline, or area of practice that none had previously possessed or could have come to on their own (Nkwodimah, 2003). The author also held that Collaborative learning activities can include collaborative writing, group projects, and other activities. Examples of Collaborative Learning Strategies include Think-Pair-Share (TPS), Reciprocal Teaching (RT) also known as Reciprocal peer tutoring, Think-Aloud Pair Problem Solving (TAPPS), Group Writing Assignment (GWA), and Group Grid (GG) (Bill, 2010).
Gender is one of the factors that have considerable effects on students' attitude especially in science subjects. Gender is the range of physical, biological, mental, and behavioural characteristics pertaining to and differentiating between the feminine and masculine (female and male) population (Adigun *et al.*, 2015). Many researchers reported gender issues in science education as inconclusive (Bilesanmi, 2002; Erinosho, 2005). Adebule and Aborishade (2014) reported that both male and female students have almost the same attitude towards science. However, David *et al.*, 2013 reported that male students developed more positive attitudes than their female counterparts. Another research concluded that there is no disparity in the attitudes of students towards science based on gender (Sakariyau, *et al.*, 2016).

Attitude is the predisposition to classify objects and events, to react to them with evaluative consistency. Attitude are formed by people because of some kinds of learning experience if the experience is favourable a positive attitude is found and vice versa (Orunaboka, 2011). Some attitudes are based on people's experience, knowledge, and skills and some are gained from other sources. However, the attitude is not stagnant /static. It changes in the couple of time and gradually (Olasheinde & Olatoye, 2014). Fasakin (2011) recognized attitude as a major factor in a subject choice. Development of positive attitudes towards science, scientists, and learning of science, which has always been a constituent of science education, is increasingly a subject of concern (Trumper, 2006).

Research has proven that students' attitude towards science subject may be influenced by the quality of his/her exposure, the learning environment, and teaching methods (Craker, 2006). If students have negative attitudes towards science subject, this may affect his/her likeness to the courses and the teachers. Based on this premise, numerous studies have been conducted to determine the factors that affect the students' attitudes towards science subjects. For instance, Students' attitude towards science is more likely to influence achievement in science courses than achievement influencing attitude (O'Connel, 2000). Similar results were stated by Edermir (2009) who affirmed that attitude, whether positive or negative, affect learning in science. However, a negative attitude towards a certain subject makes learning and retention difficult.
Empirical studies on the students' attitude and influence of gender on students' attitude towards teaching technologies have been conflicting and inconclusive. Studies on flipped classroom in especially in secondary schools in Nigeria educational context are uncommon. Hence, the need for this research to assess senior secondary school Physics students' attitude towards the three modes of flipped classroom collaborative learning strategies in Minna, Nigeria.

Statement of the Research Problem
Studies has shown that methods of teaching in which learners are not accountable for their learning but are teacher-centered have affected achievement and retention so much especially in science subjects where evaluating, analyzing, applying, and creating of ideas are highly in use. The effectiveness of blended learning like the flipped classroom over the conventional teacher-centered method had also been established through much research. However, studies on the attitude of students towards flipped classroom collaborative strategies are scanty especially in Nigeria.

Based on these facts, there is need for a study whose objective is to assess attitude of students towards flipped classroom collaborative strategies in secondary school. Physics as one of the core science subjects in secondary school has been termed difficult as revealed by numerous researches. Thus, there is need to investigate attitude of students towards flipped classroom collaborative strategies before it can be used to increase students' achievement and retention since they are the main users of the package.

Research Question

The study answered the research question:

i. What is the difference in the mean attitude rating of students taught Physics using flipped classroom in collaborative learning settings (reciprocal teaching (RT), think –aloud paired problem solving (TAPPS) and think pair share (TPS)) and those taught using individualized learning (IL) setting?

Research Hypothesis

The hypothesis was formulated and tested at 0.05 level of significance:

Ho_1: There is no significant difference in the mean attitude rating of students exposed to flipped classroom in collaborative learning settings (reciprocal teaching (RT), think - aloud paired problem solving (TAPPS) and think pair share (TPS)) and those taught using individualized learning setting.

Methodology

Research Design

The research design that was employed for this study is a quasi-experimental design which includes a non-randomized, non-equivalent, control group design. It involves four levels of independent variables, (three treatments – three collaborative learning strategies and a control – individualized learning strategy), one level of dependent variable (attitude) and a moderating variable of gender (male & female). The four participating schools were assigned to Think Pair Share (TPS), Think Aloud Pair Problem Solving (TAPPS), Reciprocal Teaching (RT) and Individualized Learning (IL) respectively.

Population of the Study

The population of this study comprised all the 27,621 senior secondary school students in Minna metropolis, Niger State. The target population of this study comprised all the 11,663 senior secondary II (SSII) Science students in Minna Metropolis, Niger State as at 2018/2019 academic session. (Education Resource center Minna, Niger State).

Sample and Sampling Techniques

The sample of this study consists of 146 science students from four senior secondary schools two (SSII) in Minna. Table 1 shows the summary of the sampled schools.

Table 1: The summary of the sampled schools

S/N	Name of School	Male	Female	Total
1	Police Secondary School Minna	21	21	42
2	Hilltop Model School Minna	17	28	45
3	FEMA Schools Minna	21	22	43
4	Brighter Schools Mjnna	8	8	16
	Total	**67**	**79**	**146**

Three sampling techniques were employed in this study. Firstly, purposive sampling procedure was adopted to select four senior secondary schools in Minna, Niger State. The schools were selected based on the following criteria (i) gender consideration (co-educational schools), (ii) school that offers Physics as a subject and (iii) schools that have computers/computer laboratory. Secondly, the selected four equivalent co-educational schools were randomly assigned to each of the three experimental and a control group using simple random sampling technique. Thirdly, a stream of class was randomly selected from each of the schools. An intact class was used in this study.

Two research instruments were used in this study: (i) Flipped-classroom instructional package (FIP), (ii) Students' Attitude towards Flipped Classroom Questionnaire (SATFCQ). The FIP for teaching Physics at senior secondary school class II (SSSII) usable at two different settings (Collaborative and individualized instructional settings) was developed by the researcher and video producer. In FIP development, a lesson plan was used for all contents included in the package. Action Script 3.0 programming and scripting language and the Adobe Flash professional were used for all the contents animations, transitional navigation, backend workings and the overall interface structure of the FIP. The voice, after being recorded was edited with the Adobe soundbooth and Adobe audition before it was added to the FIP. The lesson quiz questions were structured with extensible Mark-up Language (XML) and were loaded into the game at runtime to achieve a perfect synchrony.

The concept of Physics (light waves) selected for this study are from senior secondary school class two (SSII) curriculum. Lesson plan was prepared by the researcher, this covered the scheme of work which was produced in video instruction and was used for flipping the classroom. The FIP contains video lesson explaining the concept of Light Waves in Physics. This FIP consist of four lessons which were given to the students to access both at home and in the school. Both the experimental and control group were subjected to this instrument (FIP). They were instructed to watch the video after school hour and come the following day to work through problems and engage in collaborative learning discussion on what they have watched. This was done in two different ways: the experimental groups were assigned to three Collaborative Learning (CL) strategies: (i) Think Pair Share (TPS), (ii) Reciprocal Teaching (RT), (iii) Think-Aloud Pair Problem Solving (TAPPS), while the control group was assigned to Individual Learning (IL) strategy.

Students' Attitude towards Flipped Classroom Questionnaire (SATFCQ) made up of two sections, Section A is the Bio data of the correspondent; the name of the school and the gender while section B contains 14 items of the instrument. It was constructed by the researcher to elicit responses from students with respect to their attitude toward flipped classroom. A 5 Point Likert scale was scored as: 5 for Strongly Agree (SA), 4 for Agree (A), 3 for Neutral (N) 2 for Disagree (D) and 1 for Strongly Disagree (SD) respectively. The limit for decision rule was calculated by dividing the sum of response rating 5,4,3,2 & 1 by 5. The average mean of 5+4+3+2+1 divided by 5 is 15/3 =3. Therefore, an average mean of 3.0 was considered agreed while that of 2.90 and below was considered disagreed.

The validation of the treatments was done in three stages: the Content validation was done by three senior lecturers from Physics Department, Federal University of Technology, Minna, three senior Physics teachers from secondary schools in Minna, three experts from Test and Measurement Department of National Examination Council (NECO), Minna. Expert validation was done by some group of experts; computer specialists, Physics experts, and Educational Technology experts and Field trial validation was conducted on 20 physics senior secondary students from a secondary school in Minna.

The Students' Attitude towards Flipped Classroom Questionnaire (SATFCQ) was used for attitude rating of the Model App which was be prepared by the researcher and validated by three experts from the Department of Educational Technology Federal University of Technology Minna and two Senior lecturers from Physics Department Federal University of Technology Minna. The SATFCQ was face and content validated by three experts. All the observations and suggestions pointed out were affected and use to modify the questionnaire.
SATFQ was pilot tested on 20 randomly selected students at Bosso Secondary School, Minna, which is not part of the sampled schools but part of the research population, thus they were not used for the real study. The data obtained were analysed using Cronbach alpha formula and a reliability value of 0.81 was obtained. hence, the instrument was considered reliable.

Method of Data Collection

The researcher visited the schools to get official permission and cooperation of the school authorities to use the schools and their facilities. The facilities and the students were examined, and orientation was conducted for one week followed by administration of the pre-test. Some physics teachers were trained as research assistants in the use of FIP, individualized and collaborative learning strategies. The sampling techniques procedure and team building exercise followed immediately for two weeks.

The four weeks Physics lesson in the flipped-classroom instructional package burnt in DVD (digital versatile disc) were distributed to the students through the research assistants. Time frame was given to the students to watch the

video lessons/ read the video notes before the class lesson period. During the lesson period, students were assembled into groups. Each group followed specific Collaborative instructional strategies procedures.

Experimental group one: think-pair-share (TPS):

i. Students' learning activity involves explaining answers or ideas to another student.
ii. The instructor poses a question to the class.
iii. Students write a response and then share it with their peer.
iv. Students clarify their positions and discuss points of agreement and disagreement.
v. The instructor can use several answers to illustrate important points or facilitate a whole class discussion.
vi. The teacher (research assistant) went round the groups to moderate the students in order to ensure that guideline outlined for the method are followed appropriately.

Experimental group two: reciprocal teaching (RT):

i. Students' learning activity involves teaching one another in the group.
ii. Students jointly read a text or work on a task.
iii. Students take turns being the teacher for a segment of the text or task.
iv. In their teaching role students lead the discussion, summarize material, ask questions, and clarify material.
v. The teacher (research assistant) went round as a facilitator.

Experimental group three: think-aloud pair problem solving (TAPPS):

i. Students' learning activity involves solving problems.
(The teacher /research assistant pose a problem)
ii. Students work in pairs and alternate roles.
iii. For each problem one is the solver while the other is the listener.
iv. The solver thinks aloud - narrating his/her reasoning process—while solving the problem.
v. The listener prompts the solver to keep talking and asks for clarification but does not intervene to help.
vi. Pairs solve a set of problems and alternate role for each new problem.
vii. The teacher (research assistant) went round the groups to monitor the students in order to ensure that guideline outlined for the method are followed appropriately.

Control group: individualized learning (IL) strategy:

i. Students in this group did their learning alone on individualized bases and proceed at their own pace.
ii. Learner progresses through the material at different speeds, according to his or her own learning needs and abilities.

This specific treatment was given to each group for four weeks. SATFCQ was administered to all the groups after the treatment.

Result

Research question one: What is the difference in the mean attitude rating of students taught Physics using flipped classroom in collaborative learning settings (reciprocal teaching (RT), think –aloud paired problem solving (TAPPS) and think pair share (TPS)) and those taught using individualized learning (IL) setting?

To answer research question one, the attitudes of all the learning settings (collaborative and individualized) were scored and the means were gotten for both settings. The means show the average attitude score of the groups. A mean below 3.0 is termed as disagreed while mean score from 3.0 and above is termed agreed.

Table 2: Mean attitude scores of students taught physics using flipped classroom in different learning settings.

Treatment	Mean	S.D.	Remarks
TPS	4.05	0.43	Agreed
RT	4.12	0.29	Agreed
TAPPS	3.75	0.57	Agreed
IL	3.45	0.90	Agreed

Table 2 is the Mean attitude scores of students taught physics using flipped classroom in different learning settings. It shows the result of mean attitude rating of students taught Physics using flipped classroom in collaborative learning settings (reciprocal teaching (RT), think –aloud paired problem solving (TAPPS) and think pair share (TPS)) and those taught using individualized learning (IL) setting. TPS has a mean attitude score of 4.05 (S. D. 0.43), RT also has a mean score of 4.12 (S.D. 0.29), TAPPS recorded a mean attitude score of 3.75 (S.D. 0.57) while IL recorded 3.45 mean score with S. D. of 0.90.

From the remarks, they both cross the boundary of acceptance, and both agreed with a mean above 3.0.

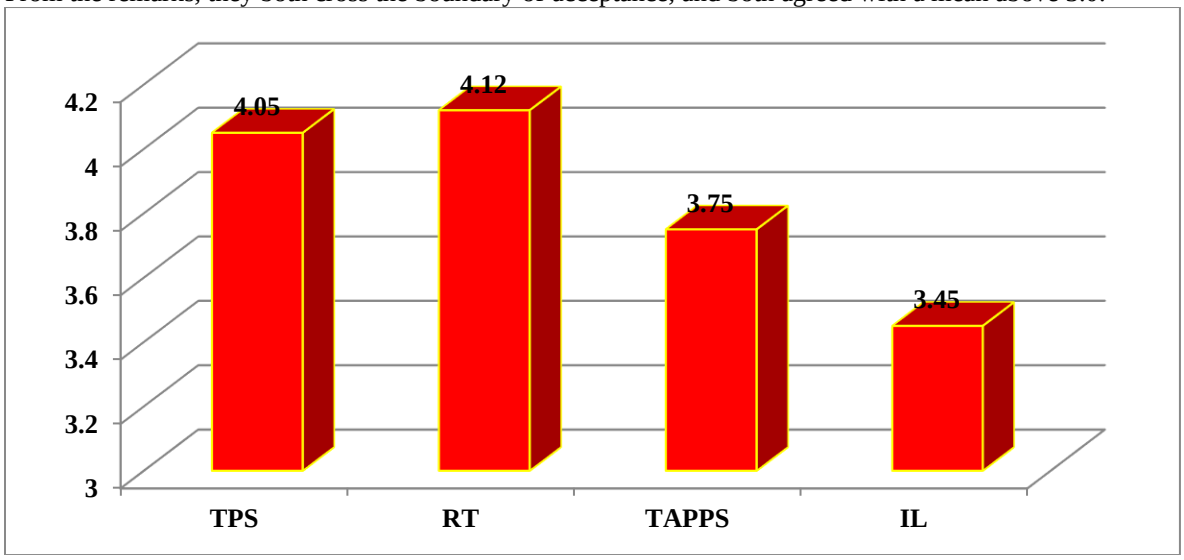

Figure 1: Attitude scores of students taught physics using flipped classroom in different learning settings.

Testing of Hypotheses

Hypotheses One: There is no significant difference in the mean attitude rating of students exposed to flipped classroom in collaborative learning settings (reciprocal teaching (RT), think - aloud paired problem solving (TAPPS) and think pair share (TPS)) and those taught using individualized learning setting.

Table 3: ANOVA comparison of mean attitude of student exposed to flipped classroom in the different collaborative learning settings (TPS, RT, TAPPS and IL).

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.042	3	3.681	3.477	.018
Within Groups	150.328	142	1.059		
Total	161.370	145			

*: Significant at $p \leq 0.05$

Table 3 is the ANOVA comparison of mean attitude of student exposed to flipped classroom in the different collaborative learning settings (TPS, RT, TAPPS and IL). shows the result of the analysis (ANOVA) showing the significant difference for the comparison of mean attitude of student exposed to flipped classroom in the different collaborative learning settings (TPS, RT, TAPPS and IL) with F (3, 142) = 3.477 and p = 0.018 ($p < 0.05$). The result revealed that there is significant difference in the mean attitude of student taught using flipped in collaborative learning setting (TPS, RT, TAPPS) and those in individualized learning setting (IL). Based on the above result, the hypothesis is rejected.

Table 4: Sidak Post-hoc analysis of mean attitude of student exposed to flipped classroom in the different collaborative learning settings (TPS, RT, TAPPS and IL).

Learning Settings	Learning Settings	Mean Difference	Sig.	95% Confidence Interval	
				Lower Bound	Upper Bound
TPS	RT	0.28571	0.92	-0.52	1.09
	TAPPS	0.48889	0.49	-0.31	1.29
	IL	-0.18605	0.99	-0.99	0.62
RT	TPS	-0.28571	0.92	-1.09	0.52
	TAPPS	0.20317	0.93	-0.39	0.79
	IL	-0.47176	0.20	-1.07	0.12
TAPPS	TPS	-0.48889	0.49	-1.29	0.31
	RT	-0.20317	0.93	-0.79	0.39
	IL	-.67494*	0.02	-1.26	-0.09
IL	TPS	0.18605	0.99	-0.62	0.99
	RT	0.47176	0.20	-0.12	1.07
	TAPPS	.67494*	0.02	0.09	1.26

*: Significant at $p \leq 0.05$

From the post hoc analysis on posttest mean attitude scores of the groups in Table 4, the following were deduced; In posttest mean attitude score, statistical difference was established between IL and TAPPS. Comparison between IL and TAPPS show statistically significant difference (mean diff = 0.68, $p < 0.05$) with an upper bound of 1.26. Also, comparisons within the other groups show no statistically significant difference ($p > 0.05$).

Discussion

The study revealed that Physics students taught using the three modes of flipped classroom in collaborative learning setting (TPS, RT and TAPPS) and those in individualized learning setting (IL) had right attitude towards the developed Flipped Instructional Package. The finding agrees with the study of (Peng and Wang, 2015) which indicated that most students made prominent improvement in their English reading ability, word recognition, and reading comprehension. In addition, most participants had positive attitude toward reciprocal (collaborative learning strategy) teaching, and they liked reciprocal teaching to be incorporated into English classes.

Conclusion

During this study, three collaborative learning strategies and individualized learning were combined into the flipped classroom method of teaching. The result from the study revealed that students had right attitude towards Flipped classroom irrespective of the learning set-up (collaborative or individualized).

Recommendations

Based on the findings of the study, the following recommendations are made:

(i) Flipped classroom collaborative learning strategies as one of the innovative teaching methods should be used to reinforce classroom instructions in the teaching of Physics in senior secondary schools.

(ii) Educational policy makers should organise seminars and workshops on blended learning for teachers on the use of modern innovative methods of teaching and learning.

(iii) Blended learning strategies (like the flipped classroom collaborative learning strategies) should be incorporated into the school curriculum plan processes.

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