Innovations

Effect of instructional conversation and gender on students' achievement, retention and attitude in towards Physics

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Abstract

The article certified the effect of Instructional Conservation and Gender on students' achievement, retention, and attitude in Senior School Physics in Delta State. The theoretical framework on which the study was anchored is Vygotsky's Social Development Theory. The study employed a non-equivalent pre-test post-test quasi-experimental design. Three (3) research null hypotheses were tested at 0.05 level of significance. A sample size of ninety one(91) SS II physics students from three (3) public senior schools in Delta State was involved. They were taught physics concepts using Instructional Conversation in the experimental groups consisted of ninety one (91) students. The instruments used were Physics Achievement Test (PAT) and Physics Students Attitude Questionnaires (PSAQ). The instruments were validated by experts in physics and science education, with reliability indices of 0.79 for PAT and 0.73 for PSAQ. The data received were analyzed using Mean, Standard Deviation, and Independent t-test. The findings revealed that Instructional Conversation was unbiased pertaining to physics students' achievement, retention, and attitude owing to their gender. Emphatically, the study stated that utilizing Instructional Conversation in teaching senior school physics is appropriate; due to the unbiased learning prospect it offered the physics learners.

Keywords: *1.Instructional Conversation, 2.Strategy, 3.Gender, 4.Achievement, 5.Retention and Attitude.*

Introduction

Background to the Study

Essentially, Physics is the natural science subject that deals with the properties of matter and its interaction with energy and force. It is typically an experimental subject. Principles and opinionsthat resulted from physics are very supportive in knowing natural happenings. The concentration of physics teaching and learning is to usher students to the understanding of physics values and to have the cognition to use this knowledge (Bebenimibo, 2022). It is a field specifically obsessed with two basic aims, the presentation of a scientifically sophisticated society and the improvement of latent scientific and technological workforce (Ogunniyi, 2001).

Accordingly, the National Policy on Education (FRN, 2004, 2007, 2013) expressed explicitly in the senior school physics curriculum its objectives as:

1. provide basic literacy of physics for functional living in the society,
2. acquire basic conceptions and values of physics as a provision for promoting studies,
3. get indispensable technological ability and cognition as a provision for the technical utilization of physics, and excite and heighten creativeness.

Physics as a fundamental science deals with the matter and energy in nature. Many students perceive physics to be difficult despite different interventions, such as the introduction of new Educational Systems. Literature (Barmby and Defty, 2006; Lavonen, Meisano, Byman, Uiito and Juiit, 2005; Angell, Guttersrud, Henriksen and Isnes, 2004; Williams, Stanisstreet, Spall, Boyes and Dickson, 2003) opined that students specifically distinguish against physics as conceptually challenging, intangible, and boring that only extraordinary exceptional students' acknowledge and endure its teaching and learning. Nevertheless, educators steadfastly accept that students acquire high-grade and accomplish in physics if they discover the instruction understandable (Gebbels, Evans and Murphy, 2010). Additionally, these writers asserted that students' conceptualization of physics determines their knowing and acquisition of the course of study.

According to Vanderhye (2007) Instructional Conversation is a situation whereby the teacher attendsprudently, makes deductions about envisionedsense, and correctsanswers to support students' efforts. In instructional conversation, the teacher associate conventional school science cognition in respect of learner's individually and collaboratively. Instructional Conversation renders possibilities for the improvement of the connection of pedagogy and course content. The scaffolding and cooperative effects of instructional conversation creates inter-subjectivity and an awareness of uniformity among learners. Instructional Conversation accomplishes personalization of direction, including collaborative and whole class setting instructions. It is possible for the use of instructional conversation in the instruction of physics to solve the problem of rote learning, poor academic performance and gender favoritism in physics experienced over the years due to inappropriate medium of instruction used in the instruction of physics.

Gender refers to socially constructed differences between male and female Ghazvini&Khajehpour (2011). Researchers, Government Agencies, and Administrators have witnessed and appear to have agreed upon generallyfashionedvariances between male and female and its important effects in their lives. Studies carried out across the world among the students studying in different levels found a significant gender difference in academic achievements. Numerous studies have shown that female students achieved better than their male counterparts (Orabi, 2007; Dayioglu&Turut, 2007; Khwaileh& Zaza, 2010). Ghazvini&Khajehpour (2011) further stated that even gender difference exists at the level of cognitive working in the academic environment. Girls are likely to be more adaptive in learning in a diverse environment. Nevertheless, Wangu (2014) in a study carried out among the students of secondary schools in Kenya observed boys passing more than girls. On the other hand, Goni et al. (2015) in a study conducted among college-going students did not observe the significant gender difference in academic performance. Studies have also observed gender inequality in the classroom because of instructional design during teaching and learning process.The importance of examining achievement, retention and attitude towards physics in relation to gender is based primarily on the socio-cultural differences between girls and boys. Therefore, the study investigated whether the achievement, retention and attitude of physics students' that were exposed to instructional conversation under study depend on gender. Researchers (Aguele and Agwugah, 2008; Kolawole, 2007; Bamidele, Odusola and Dibu – Oyerinde, 2006; and Okebukola, 2002) discovered in respect of the male learners accomplish, importantly, better than their female counterparts in physics. Also, Amoo (2011), Umar (2008) and Christine (2004) in their studies were of a different opinion that the achievements of female students in science subjects were better than that of the male counterparts. In another conflicting view also, generally in Nigeria if not Africa as a whole, it is a belief that male students are at the forefront when compared to their female counterparts in physics (Adigun, OnihunwaIrunokhai, Sada and Adesina, 2015). The comparative achievement of male and female students' in senior school physics is contradictory. This implies that an important deviation among the achievement scores of boy versus girl physics students have not been conclusively reached by researchers. Therefore, a research of this quality is necessitated.

Students' achievement, according to Hattie (2009), means a resultant effect of instruction and acquisition where certain aims with respect to the subject matter is realized, specific aims in respect of focusing on activeness with respect to educational situation, specifically in educational institutions. Students' achievement is the outcome of learning which expresses the degree of instructional objectives that have been met. Anene (2005) defined students' accomplishment as achievement in an educational institution's subject matter acquisition which is usually expressed in grade or mark obtained in a standard test. The intervention package of Instructional Conversation have shown in definite studies to significantly improve students' achievement, retention and attitude in different subject areas including physics (Kim, 2016; Fortus, Sutherland, Adams, Krajcik and Reiser, 2015; Pes, man and Ozdemir 2012; Guido and De la Cruz 2012;

Erdemir, 2009; Simha, 2000). Instructional Conversation utilization did not only improve achievement and retention, but also improved students' attitude.

Chinanson, Kurumeh and Obida (2010) while elaborating on the works of Kunbo and Tutoo (2002) explicated that students' retention is the preservative factor of the mind. They asserted that the mind acquires materials of knowledge and information through sensation and perception. When a stimulating situation occurs, retained images are revived or reproduced to make assimilation possible. In this light, when teaching physics concepts there is need for concepts to be given to the learners in ways that awaken their sub-conscious which can initiate speedy inclination of the ideas being learned or taught. Instructional Conversation isan effective instructional strategy that can serve this purpose of actually making both fast and slow learners understand and retain physics concepts through their collaborative and active learning processes.

Akinsola and Olowojaiye (2008) defined attitude as "psychological constructs theorized to be composed of emotional, cognitive and behavioural components". They further stated that impressive educational approaches will assert affirmative cognition in the learners concerning educational institution's course of study. It is generally believed that students' attitude towards physics determines their success in physics. Attitude is the inclination to deliberate consciousness and respond affirmatively or antagonistically concerning a target in our environment. They further stressed that attitude organizes thoughts, emotions and behaviours towards a psychological object. In the context of this study, attitude is the feeling of the students' towards learning physics. This feeling can be affected positively or negatively by the instructional strategy adopted by the physics teachers. The use of interactive, collaborative and student-centred instructional strategies including Instructional Conversation are capable of creating students positive attitude toward learning physics, thereby encouraging high achievement and retention in physics.

Statement of the Problem

In spite of vital efforts from the government and non-government sectors to ensure gender equality in education, there is still a serious gap between boys and girls in academic achievement, retention and attitude. Accordingly, the arguments among science education researchers with respect to Gender and students' achievement, retention and attitude in science subjects calls for further consideration, hence this research was encouraged. Hence, this study on the "Effect of Instructional Conversation and Gender on Students achievement, retention and attitude towards Senior School Physics in Delta State, Nigeria was carried out. Consequently, the problem of this study is: Is there any effect of Instructional Conversation on students' Gender and their Achievement, Retention and Attitude in Senior School Physics?

Specific objectives of the study

Specifically, this research was designed to reveal:

i. If there is any difference in the mean achievement scores of male and female physics students that were exposed to Instructional Conversation.

ii. If there is any difference in the mean retention scores of male and female physics students that were exposed to Instructional Conversation.

iii. If there is any difference in the mean attitude scores of maleand female physics students that were exposed to Instructional Conversation.

Research Questions

The following research questions have been raised to pilot this investigation.

1. What is the difference in the mean achievement scores of male and female physics students that were exposed to Instructional Conversation?
2. What is the difference in the mean retention scores of male and female physics students that were exposed to Instructional Conversation?
3. What is the difference in the mean attitude scores of maleand female physics students' that were exposed to Instructional Conversation?

Hypotheses

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

1. There is no significant difference in mean achievement scores of male and female physics students exposed to Instructional Conversation.
2. There is no significant difference in mean retention scores of male and female physics students exposed to Instructional Conversation.
3. There is no significant difference in mean attitude scores of maleand female physics students exposed to Instructional Conversation.

Methodology

The design of the study is a non-equivalent pre-test; post-test quasi-experimental design. It examines the effect of Instructional Conversation and Gender on the dependent variables. The study involved three experimental groups only, consisting of both male and female senior school physics students. A pre-test was administered to the groups, before the treatment and ensured the groups 'comparative effects of male and female in the experimental groups on achievement, retention and attitude in senior school physics. The experimental groups were taught physics concepts utilizing Gagne's learning hierarchy. A posttest was administered to the groups after the treatment period of six (6) weeks to establish the effect of the treatment on the dependent variables.

Population and Sampling Technique

This study's population involved four hundred and thirty five (435) Public Senior Schools in Delta State. The study utilized ninety one (91) SS II Physics Students from three (3) public senior schools that were randomly selected. The study utilized three (3) SS II physics whole classes of senior school II students from the three (3) designated schools. Simple random sampling technique was equally applied at every stage of selection. At the first stage, a simple random sampling was applied to designate one Local Government Area from each senatorial district. Secondly, simple random sampling was utilized to designate one (1) senior school from each of the Local Government Areas designated. Thirdly, designated senior school IIA (SS IIA) class as the intact (whole) class among the designated schools, and were assigned as the experimental groups through "hat and draw" method. This method was randomly applied and eradicated any form of bias in the selection

Validity and Reliability

The study utilized two (2) research instruments including Physics Achievement Test (PAT) and Physics Students Attitude Questionnaires (PSAQ). The Instruments were validated through face validity, content validity and construct validity. Reliability Indices of 0.79 for PAT and 0.73 for PSAQ were obtained through Kuder-Richardson formula 21 and Cronbach-Alpha formula respectively.

Treatment Procedure

I. Training of Research Assistants for Experimental Group

Three Physics teachers used as Research Assistants were trained on the techniques of using Instructional Conversation. This lasted for five days. Day one involved the researcher to request for the approval from the designated schools Principals to allow their physics instructors and pupils to participate in the study. On the second day, the researcher exposed to the three physics instructors to the theories, origin and features of Instructional Conversation. On the third day, the teachers were trained using the training manuals prepared by the researcher on Instructional Conversation. The fourth day was spent on practice and generation of ideas regarding application of Instructional Conversation in instructing Physics concepts. The trained Research Assistants were evaluated and were seen to have accurate understanding on how to apply Instructional Conversation in teaching physics contents.

II. The Step by Step Treatment Procedure

Instructional Conversation was the strategy applied as treatment. The treatment lasted for six weeks. A week before the start of treatment the researcher distributed the instructional units to the six research assistants. The instructional units contained Physics contents which includes: (i) Linear Momentum I (ii) Linear Momentum II (iii) Mechanical Energy I (iv) Mechanical Energy II (v) Heat Energy I Temperature and its Measurements and (vi) Heat Energy II Temperature and its Measurements as contained in Delta State Senior School Physics SS II plan of action. Intervention materials which were circulated earlier were based on these two reasons: (i) to familiarize research assistants with contents of the lessons and (ii) to ensure unbiased instructional presentation by following the endorsed format for the designated classes. Two days before the start of treatment, the experimental groups were pretested with the 40 items of the Physics Achievement Test (PAT) and 30 statements of the Physics Students Attitude Questionnaires (PSAQ). This was done for the groups before treatment, so that any noticed change should be as a result of the applied treatment.

Instructional Conversation

The physics teachers (research assistants) presents the physics lessons based on the eleven steps applied which include: thematic focus, activation of background schemata, successive comments, promotion of more complex expression, promotion of basis for statements or positions, few known answers and questions, responsiveness to students contributions, connected conversation, a challenging atmosphere, making cumulative contributions explicit and retention including transfer.

Thematic Focus: This involves the teacher presenting the physics lesson to the learners, while focusing on central concept, problem and interpretation using relevant inquiries with learners' responses by elaborating required central theme of the lesson.

Activation of Background Schemata: Here instructors renders learners required applicable heritage cognition concerning lesson founded with respect to the objectives.

Successive Comments: The students' comments on one another outcome instead of skipping among different issues or questions while instructors' renders relevant support.

Promotion of More Complex Expression: Here an instructor encourages students' utilization regarding text, pictures and logical thinking in influencing their statement or perspective.

Few Known Answers and Questions: Nearly all conversations centre on questions and issues for which there may be additional correct answers.

Responsiveness to Students' Contributions: With the first arrangement including keeping concentration for cohesion in conversation, instructors are equally sensitive to learners' arguments including possibilities rendered by them.

Connected Conversation: This is defined with aggregate, mutual and connected terms; ensuing vocalization created to broaden preceding statements through teachers' scaffolding to ensure concentration regarding the theme.

A Challenging Atmosphere: The teacher creates a challenging atmosphere which is balanced by a positive effective climate by asking questions relevant to the presented lesson.

Making Cumulative Contribution Explicit: The teacher provides corrective feedback as required after the students' responses and presentations by summarizing collective understanding during conversation, especially, concerning alteration occasion including conclusion.

Retention and Transfer: Students appreciate the concept and application regarding pedagogy. Learners should be capable of displaying transfer of leant concepts to related home and environmental situations.

The next lesson period after concluding treatments, students' in experimental and control groups were tested with 40 items of the Physics Achievement Test (PAT) and 30 statements of the Physics Students Achievement Questionnaire (PSAQ) after reshuffling the items. Similarly a delayed post-test was administered on the physics students four (4) weeks after treatments for retention.

Data Analysis

The data collected from the administered Physics Achievement Test (PAT) and Physics Students Attitude Questionnaire (PSAQ) were analyzed using mean, standard deviation and independent sample t-test. The significance level to which a hypothesis is rejected or not-rejected is at 0.05.

Hypothesis (HO_1)

There is no significant difference between the mean achievement scores of male and female physics students that are exposed to instructional conversation strategy.

Table 1

Independent Sample t–test on difference in the Mean Achievement Scores of Male and Female Physics Students that were exposed to instructional conversation strategy

Sex	N	Mean	mean diff	SD	$t_{(val)}$	df	$sig_{(2\text{-tailed})}$	Remark
Male	48	56.92		7.22				
			-1.01		-0.63	89	0.53	Not Significant
Female	43	57.93		8.23				

P > 0.05

In table 1, the posttest p-value is 0.53 and was greater than the alpha level of 0.05. This implied that posttest mean scores of male and female physics students' that were exposed to Instructional Conversation Strategy has nosignificant difference. With this result, the null hypothesis was not rejected.

Hypothesis (HO_2)

There is no significant difference between the mean retention scores of male and female physics students that are exposed to instructional conversation strategy.

Table 2

Independent Sample t-test on the difference in the Mean Retention Scores of Male and Female Physics Students' that were exposed to Instructional Conversation Strategy

Sex	N	Mean	Mean diff.	SD	$t_{(val)}$	df	sig $_{(2tailed)}$	Remark
Male	48	42.23		8.33				
			1.23		0.64	89	0.52	Not significant
Female	43	41.00		9.85				

P > 0.05

Table 2 specifies t-value of 0.64 and p-value of 0.52. Comparing the p-value with the alpha level, the p-value of 0.52 is higher than the alpha level of 0.05. Therefore, the null hypothesis was not rejected. This reveals a situation of no significant difference between the mean retention scores of male and female physics students exposed to Instructional Conversation Strategy.

Hypothesis (HO_3)

There is no significant difference between the mean attitude scores of male and female physics students' that were exposed to instructional conversation strategy.

Table 3
Independent Sample t-test on the Difference in the Mean Attitude Scores of Male and Female Physics Students' that were exposed to Instructional Conversation Strategy

Sex	N	Mean	Mean diff.	SD	$t_{(val)}$	df	sig $_{(2tailed)}$	Remark
Male	48	87.02	-3.31	9.11	1.53	89	0.13	Not significant
Female	43	90.33		11.47				

p>0.05

The result in table 3 indicated the t-value of 1.53 and p-value of 0.13. Testing the null hypothesis at an alpha level of 0.05, the p-value of 0.13 was higher in comparison with alpha level of 0.05. Hence, the null hypothesis was not rejected. This disclose a situation of no significant difference among the mean attitude scores of male and female physics students that were exposed to Instructional Conversation Strategy.

Discussion

The findings in hypothesis (HO_1) disclosed a situation of no significant quality with respect to posttest mean achievement scores of male and female physics students that were exposed to Instructional Conversational strategy. The observed no substantial change in the mean achievement scores of male and female physics students revealed that students' achievement in physics is irrespective of gender. Conceivable clarifications to this discovery could be thatInstructional conversation strategy has provided both male and female physics students' equal opportunity to participate effectively in physics learning and it has encouraged them in building self-confidence in solving physics problems and ensured effective achievement as evident in this study. This finding agrees with Uduosoro (2011), where he found no significant superiority concerning achievement of boys and girls. The finding of this study however, negates the finding of Okwo and Otunba (2007), Umar (2008) andAmoo (2011) who asserted significant difference between male and female students' performances in science subjects in favour of either gender. The finding of this study reaffirmed that the treatment applied in this study were not in favour of a particular gender, hence there was no significant difference between male and female physics students achievement.

The result in hypothesis (HO_2)disclosed a situation of no significant excellence regarding the mean retention score of male plus female pupils' instructed in physics using Instructional Conversation strategy. The observed no substantial difference in the mean retention scores of male and female physics students revealed that students' achievement in physics is irrespective of their gender. Instructional conversation strategy has provided male and their female counterpart equal opportunity to participate effectively in physics learning and it has encouraged them in building self-confidence in solving physics problems and ensured effective retention as evident in this study. The discovery conforms to Alexander (2009) who affirmed with respect to a situation of no significant quality between male and female students exposed to Instructional Conversation strategy and their mean retention score in physics. This investigation contradicts that of Lefstein (2006) who finds a significant quality regarding the mean retention scores of students exposed to Instructional Conversation strategy in favour of the male students in science. The current investigation, also, contradicts the views of Johnson, Betancourt, Villarreal and Rodriguez (2013) who reported that females in the experimental group (Instructional Conversation) significantly performed better than their male counterparts in science. Another probable reason for this no significant excellence between male and female physics students could be as a result of the effective application of the treatment to the senior school physics student, which has presented equal opportunity to both male and female learners.

This outcome regarding hypothesis (HO_3)disclosed a situation of no significant quality regarding to mean attitude score of male and female pupils instructed in physics using Instructional Conversation strategy. The observed no substantial change in the mean attitude scores of male and female physics students revealed that students' attitude in physics is irrespective of sex. Instructional conversation strategy has provided male and female physics students' equal opportunity

to participate effectively in respect of instruction-acquisition situation and it has encouraged them in building self-confidence in solving physics problems and ensured positive attitude in physics as evident in this study. The current study's discovery conforms to Alexander (2009) who declared a situation of no significant quality between male and female students exposed to Instructional Conversation strategy and their mean attitude score in physics. The current findings contradicts Lefstein (2006) who finds a significant quality with respect to mean attitude scores of students exposed to Instructional Conversation strategy in support of the male students in science. One probable reason for males outperforming females in senior school science may be as a result of their assertiveness in the classroom and seeing their future responsibility as providers for the family. The current investigation contradicts the views of Johnson, Betancourt, Villarreal and Rodriguez (2013) who reported that females in the experimental group (Instructional Conversation) significantly performed better than their male counterparts in science. A probable explanation for females outperforming males in science may be that they now have reason to invest their energy in academic success in science, rather than baby makers who do not have need good grades. However, the finding of this study has ensured that gender is not a determining fact in respect of students' attitude in senior school physics with utilization of Instructional Conversation as treatment.Alternativefeasible reason for this detection of no significant difference in male and female physics students should be as a result of the collaborative and cooperative learning opportunities provided by Instructional Conversation strategy

Conclusions

The findings of this research, has exposed that Instructional Conversation strategy as described with respect to this inquiry has the ability in fixingfundamental problems involving male and female students in instructing science subjects. Owing to the fact that it has viable empirical support and its ability to facilitate students effective learning and organized knowledge content in a meaningful way, as well as its ability to make knowledge acquired to be long lasting among the learners without gender bias makes it an appropriate alternative among other instructional strategies for teaching science. This study has revealed that physics contents taught using Instructional Conversationhas ensured positive attitude, improvedknowledge gaining and retaining of science concepts among male and female physics students while eradicating biasness. The designof teacher-student interactions during instruction and obtaining knowledge has positive effects on the learners without been gender biased. The prominent purpose of teacher-student interactions during Instructional Conversation is to ensure active students participation that should be stimulating critical thinking and problem solving skills among physics learners irrespective of their gender.

Further research into Instructional Conversation could help science educators to understand the following better: (i) the impact of Instructional Conversation and location on students' achievement in physics. (ii) Instructional Conversation strategy and achievements as correlates of attitude in physics. (iii) what is the influence of teachers attitudes toward the application Instructional Conversation in teaching science.

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