Impact Assessment of Pedagogical Content Perception of Biology Teaching in Schools

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Abstract:- The type of instructional strategy adopted by biology teachers is a contributory factor influencing students' perception of biology teaching using a blend of pedagogical knowledge, as well as other bases of the teacher's potential to facilitate students' understanding, skill acquisition, application of the knowledge gained in solving problems as well as improving students' perception of biology teaching. Thus, the pedagogical content perception of biology teaching. This study adopted quasi-experimental design using 2 x 2 factorial matrix of pre-test, post-test and control group with two treatments of PCK and traditional method as the control. A sample of 618 students in Senior Secondary School II comprising 290 students (%=46.93) in the science group with 328 (%=53.07) in the non-science group. Data was collected using research instrument titled Students' Perception of Biology Teaching Questionnaire (SPBTQ) and one instructional strategy contained in Pedagogical Content Knowledge (PCK) Instructional Package for teachers (PCKIPT). Data was analysed using Analysis of Covariance (ANCOVA). Hence, significant main effects of treatment on students' perception of biology teaching. PCK instructional strategy was found to be far better than the traditional method while gender had no significant effect on students' perception of biology teaching. PCK instructional strategy significantly improves students' perception of biology teaching. Therefore, biology student centred strategies' such as PCK Instructional strategy in enhancing students' perception of biology teaching and learning.

Keywords:- *Pedagogical Content Knowledge (PCK), Students' Perception, Biology Teaching Gender.*

I. INTRODUCTION

The teachers, the world in general and Nigeria in particular need for the actualization of the sustainable developmental needs of the society, are teachers that make teaching and learning interesting, understandable, meaningful and certified competent rather than those with ordinary paper qualification. They are teachers that can transform content and pedagogy into meaningful learning outcomes. Teachers with good knowledge base that includes: knowledge of content, pedagogy, students, context of learning, language, curriculum and gender among others are teachers t hat can meet the demand of 21st century teaching and learning skills. The knowledge that integrates and transforms the teachers' pedagogical competence is what actual differentiates him from a non-competent teacher.

Pedagogical content knowledge originated from Shulman (1986) in answering questions arising from teacher's knowledge and competency, he emphasised teacher's knowledge and pedagogy being treated as mutual exclusive instance, affirmed practical exclusion as product of teacher education programs in which a focus on either subject matter or pedagogy dominated. To address the dichotomy, he considered the relationship between the two by introducing a notion called **pedagogical content knowledge**.

In Shulman opinion, pedagogical content knowledge includes most useful forms of representation of (topics), the most powerful analogies illustrations, examples, explanations and demonstration. The ways of representing as well as formulating the subject that makes it comprehensible to others, which includes an understanding of what makes the learning of specific topic easy or difficult, that is, the conceptions and preconceptions that students of different ages and background bring with them to the learning environment. Pedagogical content knowledge is an accumulation of common elements like knowledge of subject matter, knowledge of student and possible misconceptions, knowledge of curriculum and knowledge of general pedagogy. PCK is knowing **what, when, why** and **how** to teach using a reservoir of knowledge of good teaching practice and experience in producing individuals that can contribute meaningfully and positively in solving the challenges threatening man's existence on planet earth. The key elements of Shulman's conception includes: **knowledge representation** and **knowledge presentation.** Knowledge representation involves the planning of the instruction by the teacher, putting into consideration what to be taught, why, when, who to be taught and how it will be taught. Knowledge presentation, however, refers to everything the teacher does in the classroom to make the lesson meaningful and understandable to the learners. It includes all the informative analogies, examples and demonstrations the teacher inculcates into the teaching to bring about meaningful learning outcomes. Pedagogical Content Knowledge in science teaching is fairly well-documented in literature.

Studies have shown that one of the purpose of learning Science, Technology and Mathematics Education (STME) is mainly to produce Scientists and Engineers who will continue the research and development that is central to the economic growth of our world as well as technological proficient workers who are capable of dealing with the demands of a science-based high technology workforce and scientifically literate global citizens who make intelligent decisions about public policy and who understand the world around them (Obomanu and Adaramola, 2011). The means to achieve all these, depend much on students' perception of science teaching and high achievement in science, technology and mathematics education . It is challenging that students do not actually achieve as high as expected in Science subjects and Technology as well as Mathematics (STM) to meet the challenges of the nation. Most students do not perform well in STM related subjects such as Further Mathematics, Chemistry, Biology and Mathematics in internal and external examination (Ajagun, 2006; Anoh 2015). One of the reasons for re-occurring poor performance recorded in STM in general and biology in particular is due to students' inability to understand some concepts in biology (Obomanu and Adaramola, 2011). This can be attributed to teachers' use of ineffective teaching method and students' perception of science teaching and learning.

In the last two decades, studies about students' learning outcomes focused primarily on educational objectives in the cognitive domain, but recently attention seems to have focused more on outcomes in the affective domain. Learning outcomes on affective domain of the education objectives are as well necessary as cognitive outcomes and its acknowledgement is reflected in increasing efforts in research studies. Students' perception of science teaching, science teacher and even the classroom environment help them to form their attitude (opinion, feeling) positively or negatively towards the subject. Furthermore, to determine the factors that negatively affect students' learning in biology, and to understanding students' views (perception) on what makes biology teaching effective becomes crucial. When students are not happy about the way a subject is being taught, they may show disinterest and negative attitudes in that subject and its teaching. Macbeath, Schratz, Meuret, & Jakobsen (2000) supported this view by asserting that schools that acknowledge the significance of students' perception irrespective of gender have found that it can make a substantial contribution to their classroom management, learning and teaching as well as to the entire school as a social and learning environment.

There is a general growing concern the world over, about under-representation of gender inequality in Science, Technology and Mathematics (STM) courses. Although several attempts have been made to address the issue, the problem seems to remain. In Nigeria, in spite of government financial investments on education, introduction of nine years free and compulsory basic education for all children of school age (FRN, 2004) and determination to promote gender equity in science and technology education at all levels of the education system, gender disparity in education and employment opportunities exists (Oyekanmi, 2016).

Reports further stated that Women and girls are under-represented in science, technology and engineering fields, and the few women and girls that venture into such fields are discriminated against in employment opportunities. Okebukola (2004) said, in spite of the fact that 50% of the population of Nigerians were women, only 11% of personnel in science, technology and engineering professions are women. Ogunleye (1999) also reported that women form more than 50% of the Nigerian population according to the 1991 census figures; women (girls) still underachieved and were under-represented in science, mathematics and technology education. Their underachievement was seen from their performances in West African School Certificate Examination (2005-2011).

The issue of gender in science, class-type (science and non-science) and achievement are still inconclusive. Some research reports indicated that gender inequality exist as gaps in students' achievement in science, technology and mathematics education. Others still believed that the gap has been bridged to the barest minimum or has disappeared.

II. STUDIES ON STUDENTS' PERCEPTION OF SCIENCE TEACHING

Domin (2007) in a study, investigated Students' perceptions on when conceptual development occurs during laboratory instruction. Seventeen (17) first year students in a B.Sc programme were used as sample for the study. Questionnaires and interviews were the instruments used in the study. During the course of the study, the students experienced the first semester of laboratory instruction in general chemistry using problem-based format. This was followed by a semester in which the laboratory portion of the course was taught in a traditional manner. Other laboratory instructional styles used in instructions are inquiry, discovery and expository style. At the end of the second semester, all the students were administered the questionnaire regarding their perceptions of the different laboratory instruction. The study revealed that the students believed that the problem-based environment helped them better understand course concepts relative to traditional laboratory instruction. Other students perceived conceptual development to be occurring at different times during the various types of instruction (Domin, 2007).

Wolter, Lundeberg, Kang and Herreid (2011) in another study, examined students' perceptions of using personal response systems ("Clickers") with cases in science, evaluated whether or not a new pedagogy using personal response systems (clickers) along with case study teaching improved students' perceptions of their understanding of science in biology classrooms. One thousand four hundred and fifty seven (1,457) students across the United States and Canada were used as sample for the study. The instruments for the data collection were Questionnaire and interview. The questionnaire used was developed from Duncan's (2005) instrument, (measure the use of clickers in large lecture classrooms). Yadav, Lundeberg, De-Schryver, Dirkin, Schiller, Marier and Herred (2007) carried out a survey (measuring the use of cases). The instrument was revised multiple times by faculty and researchers. The faculty taught six to eight topics in biology by lecture or clicker case method, alternating the methods within the same course.

It can be said that Case-based learning is a promising practice in science, technology, engineering, and mathematics (STEM) that has increased student interest, participation, and understanding of science material (Yadav et 'al, 2007). Case based instruction allows students to make a personal connection to material by presenting it in a context that is relevant to them. When students discuss real-world problems in situated learning contexts, material becomes more engaging and students become more motivated to learn. On the other hand, personal response systems provide immediate real-time feedback to students directly influencing their learning. The successful use of clickers is associated with feedback and student motivation. When students feel involved, they are more apt to create linkages between existing knowledge and the material taught. Clickers generate student engagement by allowing immediate feedback to flow from students to the teacher, thus providing students with a tool to influence instruction. Results indicated that students, especially females and non-science majors, were generally positive toward the use of both clickers and cases. Also, all the variables significantly influenced both general attitudes and perceptions of ease of use. Students' attitudes were influenced by gender. Female students had more positive opinions of clickers and were more comfortable adopting them than the male, although effect sizes were small indicating that gender accounted for only half a percent of variance.

Bernardo, Limjap, Prudente and Roleda (2008) investigated students' perceptions of science classes in the Philippines. The sample for the study comprised seven thousand, eight hundred and eighty eight (7,888) grade school and high school students in different provinces in the Philippines. The basic education system in the Philippines involves six years of elementary and four years of high school. The participants in the study involved those in the last two years of elementary (grades 5 and 6), and the first to fourth years of high school (referred to as grades 7-10). All the participants took a mandatory science subject in the basic education curriculum. A modified version of the Perception of Science Classes Survey (PSCS) from Kardash & Wallace (2001) was used as instrument for the study. The items were grouped under five factors namely: Factor 1 represented perceptions about the teachers' student-oriented pedagogy; 2 represented learning activities intended to promote science inquiry; 3 represented the affective and motivational dimension of science learning; 4 indicated how students are given appropriate feedback through their grades, and 5 indicated how the teacher and classroom supports students' attempts to learn. Factor analysis revealed five dimensions of the students' perceptions that relate to different aspects of the teacher's pedagogy and the learning environment created by the teachers: (a) Learner-Centred Pedagogy, (b) Science Inquiry Activities, (c) Positive Effect and Attitudes, (d) Grades as Feedback, and (e) Support for Self-Learning and Effo rt. Factor scores were compared across grade levels and genders. The results indicated a decrease in science inquiry activities and the use of grades as feedback in the higher grades, but an increase in support for self-learning and effort, and also positive effects and attitudes. The female students perceived more student-centred pedagogies compared with their male counterparts. There was no interaction between gender and grade level.

Ampadu (2012) viewed students' perceptions of their teachers' teaching of mathematics using the case of Ghana, examined students' perceptions of their teachers' teaching practices and how it impacts on their learning experiences. The sample of the study involved three hundred and fifty eight (358) students (148 males and 210 females). The questions were grouped into three sections. Section A gathered personal information about the students and their school, whether they like mathematics and if they intend to read mathematics related subjects at senior high school. Section B assessed students' learning experiences which were intended to examine the students' perceptions regarding how they learn mathematics in their respective classrooms. Section C gathered information on students' perceptions of their teachers' teaching practices. Therefore, the study revealed that the students' perceptions of their teachers' teaching vary as the results established that both teacher-centred and student-centred teaching approaches were used by the mathematics teachers. The study also established that teachers' actions and inactions impact positively or negatively on students learning experiences as majority of the respondents reported that their learning experiences were to a larger extent controlled by their teacher. A majority of the respondents indicated that their teachers normally tell them which questions to solve and which methods to use.

Gömleksiz (2012) in another study, examined elementary school students' perceptions of the new science and technology curriculum by gender explored the students' perceptions of science and technology classes in a Turkish elementary school context. He determined whether there were any statistically significant differences among elementary students' views toward importance, necessity, learning environment of science and technology classes and teaching strategies of their science teachers in terms of the gender variable. One thousand, five hundred and fifty eight (1558) sixth-grade students in different schools formed the sample for the study. Data for the study were collected through a five-point Likert scale questionnaire. The results of the study revealed that there were statistically significant differences observed in the gender of the students. Male students considered learning science and technology more necessary and important than female students did. They also found learning environment and teaching strategies more sufficient and effective than females did. Findings further revealed that male students were not satisfied with what the teachers practiced in science classrooms.

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In yet another review, Onwuocha and Nwakonobi (2009) investigated students' perception of classroom interaction of their biology teachers. Using a correlation design and a sample of one thousand, two hundred and sixteen (1216) senior secondary school II students, randomly selected from nine schools in the Onitsha Education Zone of Anambra State, the study showed that biology students perceived their teachers mostly as leaders in the class, understanding, admonishing and strict. The students did not perceive their teachers as helpful/friendly, allowing responsibility and freedom. The students manifested many negative feelings about their biology lessons and teaching. Leadership, helping and understanding teacher classroom interaction were positively correlated while uncertainty, admonishing and strictness were negatively correlated with students' perception towards biology teaching.

Telli, Cakiroglu and Broke (2006) examined high school students' perception of their classroom environment in biology and the relations between these perceptions and students' attitudes towards biology. The study further investigated the difference in students' attitude towards biology by gender, grade level and parental education. A total of one thousand, nine hundred and eighty three (1983) ninth and tenth grade students from 57 biology classes at schools in two Turkish cities were involved as sample for the study. The instruments used in collecting data for the study were an adapted and translated version of "What Is Happening in This Class (WIHIC)" and the Test of Science Related Attitude (TOSRA) questionnaires. Findings from the study revealed that students' perception of their learning environment in biology were significantly associated with their attitudes. In addition there were significant differences in gender and grade level towards their perception of classroom environment and teaching. Further studies have shown that the classroom learning environment can be seen as a determinant of students' learning outcome.

In a similar study, Telli, Brok, Tekkaya and Cakiroglu (2009) investigated effect of gender and grade level on Turkish secondary school students' perceptions of a biology learning environment. The sample for the study comprised one thousand, four hundred and seventy four (1474) high school students. "What is Happening in This Class" (WIHIC) questionnaire that was developed by Fraser, Fisher and McRobbie (1996) was used as an instrument for the study. The questionnaire maps out several important dimensions of the classroom learning of biology and classroom environment as the degree of investigations, cooperation, the extent of teacher support, students cohesiveness, students involvement, task orientation and gender equity. Findings from the study indicated that there was significant gender and grade-level differences among the participants. The differences were in favour of the male students. While Fraser (1998) made an overview of 40 students describing different countries, grade levels and types of classroom and found a close relationship between students' perceptions of their classroom learning environment and their success.

Santiboon, Chumpolkulwong, Yabosdee and Klinkaewnarong (2012) assessed science students' perception of the learning activities in a physics laboratory classroom at Udon Thani Rajabhat University. The sample for the study comprised five hundred and seventy seven (577) students in 13 science and technology programme. Physics Laboratory Environment Inventory (PLEI) and the Test of Science Related Attitude (TOSRA) were the instruments used for data collection. Findings from the study revealed that students showed relatively favourable perceptions of their laboratory lessons, the lowest score occurring for the material environment scale. It showed therefore, that laboratory lessons or practical activities related to physics lessons were operated rather as supplementary to theory classes rather than being independently important in their own rights, which implies that Thai physics teachers/lecturers usually do not place much value on laboratory activities which guaranteed satisfactory student' achievement in laboratory lessons.

III. STUDIES ON TOOLS FOR MEASURING TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE (PCK)

Several research efforts attempt to describe the knowledge base that influences teachers' approaches to teaching which is believed to be difficult to categorise and document (Cochran-smith and Lytle 1999). However, attempts to articulate links between teachers and their knowledge proved difficult because teachers' practice and the theoretical knowledge that influence their practice are often hidden or difficult to explain. This is why some teachers explain their achievements with particular events, students or classroom. Investigating teachers' PCK have been done through a variety of approaches like comparison of experienced and non-experienced teachers' knowledge, observation, interview as well as discussion. These have been used to describe teachers' PCK but they can provide only limited insight into teachers' PCK because PCK is partly hidden. It is covert and overt in nature. There was need for a method or tool for articulating and documenting teachers' PCK to enable teachers share their knowledge base in a meaningful form within their professional community in a way that will benefit others.

In an attempt to address the problem of capturing and portraying PCK in a more meaningful way which have confounded previous research Loughram, Mulhall and Berry (2004) developed a method with two important elements/tools (Content Representation (CoRe) and Pedagogical and Professional Experience Repertoire (PaP-eR)). The first tool Content Representation (CoRe) is linked to particular science content. It explains or reveals science teachers understanding to particular aspect of pedagogical content knowledge. Content Representation covers the following: an overview of the main ideas; knowledge of alternative conception, insightful ways of testing for understanding; known points of confusion; effective sequencing and important approaches to the framing of the important aspects of a particular concept. CoRe is both a research tool used to access science teachers' understanding of the content as well as a way of representing the teachers' knowledge across the content area being examined, thereby helping the teachers identify important features/aspects of the content to be taught. CoRe is also used as an instructional tool to develop science teachers' pedagogical content knowledge (Loughram , Berry and , Mulhall 2006). The steps for preparing content representation (CoRe) for any topic include: writing out the important aspects of the selected topic the teacher must teach; what the teacher intends the students to learn about each of the important aspects of the topic; why it is important for students to know these important aspects of the topic; other alternative information or ideas about the topic that the teacher do not intend the students to know yet; difficulties/limitations likely to be encountered in teaching the topic; knowledge of students' thinking that will influence the teaching of the topic; knowledge of other factors that can influence the teaching of the topic; the teaching procedures to be adopted in the teaching of the topic as well as specific ways of ascertaining students' understanding or confusion around the topic (Loughran, Mulhall & Berry 2004, Loughran, Berry & Mulhall 2006).

Pedagogical and Professional Experience Repertoire (PaP-eRs) as the second tool is linked to the teaching practice. It is attached to the content representation by illustrating how a particular knowledge might inform effective classroom practice. It explains the connection between teaching and learning for meaningful understanding of the science concept. PaP-eR helps to illustrate PCK in the classroom. It gives narrative account of a teacher's PCK that highlights a particular aspect of science content to be taught. PaP-eR varies depending on what it intends to portray. For example, some PaP-eRs are drawn from students' perspective, others from that of the teacher, some take the form of an interview, others a classroom observation or teacher's reflective thinking of the problems inherent in a given topic.

Rowan, Schilling, Ball, Miller, Atkins-Burnett, Camburn, Harrison and Phelps (2001) developed a survey-based instrument in form of questionnaires for measuring teachers' pedagogical content knowledge in any subject area. The questionnaire is constructed so that each classroom scenario is followed by one or more multiple choice questions under the facets of PCK to be covered. All scenarios have multiple choice questions designed to measure a single facet of teachers' pedagogical content knowledge (teachers' content knowledge and knowledge of students' thinking). The scenarios and associated questions measure both teachers' content knowledge and knowledge of students' thinking for each selected concepts/topics under study. The items are analysed using 'BILOG' a programme for item analysis and scoring.

Aaltonen and Sormunen (2013) used the lesson preparation method in explicating the development of science teachers' PCK. The science teachers were asked to design a 45-minute or 90-minute lesson plan to introduce a specific topic to a class of a certain age and level. They were not allowed to use any materials for the task, which was carried out at the beginning of an academic year. The second phase was conducted just at the end of the academic year and the science teachers were asked to plan the same topic as they did previously. This method was used successfully to develop science teachers' knowledge of curriculum and instructional strategies.

Statement of the Problem

Many factors which are cognitive oriented have been enumerated as those responsible for the poor performance recorded in schools especially in biology. Such factors include poor subject matter knowledge, inadequate acquisition of practical skills, difficult concepts, ineffective teaching strategies and lack of competence by biology teachers among others. Studies are increasingly recognising the impact of student-centred instructional strategies in improving students' affective factors such as self-concept, attitude, self-efficacy, students' interest and the way students' perceive the way science is being taught as being responsible for students' performance in science subjects (Domin, 2007; Onwuocha & Nwakonobi, 2009; Ampadu, 2012; Anoh, 2015; Oyekanmi, 2016). A lot of studies have focused on using different strategies like concept mapping, cooperative learning, and vee-mapping, in improving students' achievement in biology without substantial improvement in students' learning outcomes in biology. However, studies that explain how Pedagogical Content Knowledge (PCK) influences students' perception of biology teaching in Senior Secondary School in Nigeria are few. In addition, the role that society associate gender with (male and female) may also influence the way students perceive biology teaching and it is on this premise that this study was founded.

Research Questions

1. What impact has treatment on students' perception of Biology teaching?
2. To What Extent Will Treatments Affect Students' Perception of Biology Teaching Based on Gender?

Hypotheses

1. There is no significant main effect of treatment on students' perception of Biology teaching
2. There is no significant main effect of gender on students' perception of Biology teaching
3. There is no significant interaction effect of treatment and gender on students' perception of Biology teaching.

IV. METHODOLOGY

The study adopted quasi-experimental design. The specific form of the quasi-experimental design was the 2 x 2 factorial matrix of pre-test, post-test, non-equivalent control group. The first 2 represent treatment at two levels of Pedagogical Content Knowledge which represent the intervention and the conventional practice that represent the control. The other 2 factorial was the class type at two levels and these are: science and non-science groups. The design was deemed suitable as it was able to adjust for the initial differences that exist on a covariate as well as controlling for other extraneous effects that may want to affect the potential outcome of the study. The population of the Study comprises all the biology teachers in the 319 Senior Secondary Schools in Lagos state, which formed the population for the study. The sample was made up of six hundred and eighteen (618) senior secondary II students in Lagos state. This was componential of four hundred and fourteen (414, %=66.99) students in the experimental group with (n=204, %=33.01) students in the control group. Divided along the class type, the sample was componential of 290 students (%=46.93) in the science group with 328 (%=53.07) in the non-science group. Two educational districts were randomly selected from the existing six educational districts in Lagos state. Five secondary schools each were randomly selected from Educational districts III and V making a total of 10 Senior Secondary Schools in Lagos state, Nigeria. Two intact classes were randomly selected from each of the 10 schools selected making a total of 20 intact classes. From those 20 intact classes emerged 618 students.

Instrumentation

Two instruments were employed in this study. They were developed by the researcher. One of the instruments is teacher centred and the other one specifically for the students. The instruments are:

1. Pedagogical Content Knowledge (PCK) Instructional Package for teachers with teachers instructional guide
2. Students' Perception of Biology Teaching Questionnaire (SPBTQ)

Pedagogical Content Knowledge (PCK) Instructional Package for teachers (PCKIPT)

There were a total of nine sessions in this package.

Session I: Discussion on Teaching Methods
Session 2: Teaching Techniques.
Session 3: Classroom Management, Learning Styles, Modalities and multiple intelligences.
Session 4: Writing of a good Lesson Note
Session 5: Introduction of Content Representation (CoRe) as an instructional tool for PCK
Session 6: Discussion on the use of CoRe
Session 7: Comparison of participants' CoRe with the researcher's copy.
Session 8: Micro teaching that is videotaped, and carried out as practice, followed by the observation of video clips for reactions, reflections and corrections.
Session 9: Trial session done in a real classroom where the teachers (participants) are assessed by experts in PCK to confirm mastery of the strategy using a check list (observation schedule).

Teachers' Instructional Guide on PCK Instructional Strategy for the Experimental Group

Stage 1: Introduction

- Review of last lesson and building background/ previous knowledge. The teacher sensitizes the students and uses analogy as an example to make a connection between the previous knowledge and the new topic.

Stage 2: Conceptual knowledge base presentation by the teacher: The teacher states the following in steps:

- Learning/lesson objectives and purpose
- Key vocabulary/words students need to understand to facilitate learning
- Resources, materials that can aid teaching and learning
- Strategies and techniques that can help students achieve the lesson objectives example (analogies, illustration, observation, concept mapping and argumentation)
- Difficulties/ limitations connected with the lesson that can affect students understanding of the lesson.

Stage 3: Activity-based practice:

Procedure/ Activities are stated in steps:

- How the teacher teaches the content of the lesson
- What the students do as the lesson goes on (putting their thinking down on paper, creating ideas, drawing, performing experiments among others).
- The number of steps a teacher may have in this stage is dependent on the number of stated lesson objectives.

Stage 4: Evaluation/Assessment

The teacher ascertains students' understanding or confusion around the lesson through questioning, drawing concept maps and argumentation among others.

Stage 5: Feedback and Review

- The teacher encourages and motivates the students' effort.
- Makes final review/ summary of the lesson.
- Gives assignment to help the learner further apply acquired knowledge.

Teachers' Instructional Guide for Conventional Lecture Strategy

The salient points are as shown as follows:

Learning Objectives: Teacher states the objectives of the lesson to reflect on those things the students should be able to achieve by the end of the lesson.
Previous knowledge/Entry behaviour: Teacher states what students have treated or known in relation to the new topic
*Instructional materials***:** She states and uses charts, models and real objects, among others, during instruction.
Content: Teacher states and explains in detail the content of the lesson without involving the learners
Presentation Instructional Procedure: (in steps) Depends on the teacher.
Summary: Teacher summarizes the lesson before evaluation.
Evaluation: Teacher asks questions orally on the topic taught
Conclusion: She concludes and allows the students to ask questions.
Assignment: She asks the students to read up the next topic for their next lesson

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The Teacher' Guide on Conventional Lecture Strategy and PCK Instructional Strategy were given to seven qualified and experienced secondary school biology teachers to determine the workability and the procedural effect of the instructional guides as well as their suitability for the study. After this had been done, the corrected versions were given to two qualified and experienced biology teachers to try on the selected concepts. Modifications were made to get the final drafts. The teachers used in trial testing the instructional strategy were not from the schools used for the study.

V. STUDENTS' PERCEPTION OF BIOLOGY TEACHING QUESTIONNAIRE (SPBTQ)

This is a four point-Likert-type questionnaire developed by the researcher to determine the perception of students towards biology teaching by the teachers treated with PCK instructional package and the conventional lecture method. It was a 20-item questionnaire developed to determine the perception of students towards biology teaching. The students were to select either Strongly Disagree, Disagree, Agree or Strongly Agree. The Students' Perception of Biology Teaching Questionnaires expresses feeling which the students have towards biology teaching. The students are to express the extent of agreement between the feeling analyzed in each statement and their own feeling indicating how closely they agree or disagree with the feeling expressed in each statement as it concerns them. The statements are categorized to include the following: teacher's mastery of biology content, teaches for understanding, motivates and encourages students to learn, uses a variety of instructional materials, uses formative and summative assessment, among others. Direct scoring was donefor positive items in the order of SD = 1, D = 2, A = 3, SA = 4, respectively. The maximum obtainable score is 80 while the minimum score is 20. The average score of 40 and above is considered positive and high perception while scores less than 40.0 are considered negative or low perception

The validity of Students' Perception of Biology Teaching Questionnaire (SPBTQ) was done using expert validity giving copies of the instruments to experts in questionnaire construction to ascertain whether it measures what it purports to measure. Some items were discarded based on advice. The reliability was determined using test-retest over a period of two weeks and the values correlated using Pearson Product Moment Correlation Coefficient and it gave value of 0.80

Pre-test scores were collected on students' perception of biology teaching. Thereafter, students were exposed to the intervention using five stages of PCK instructional strategy and the conventional lecture strategy.

Data was analysed using mean, mean gain, % mean gain, standard deviation, Cohen's d, partial eta squared, analysis of covariance and pair-wise comparison. This was done along the lines of stated research questions and hypotheses. Hypotheses were tested at the level of significance of 0.05. Data was analysed using Statistical Package for Social Scientist (SPSS) Version 20.0.

Research Question 1

What impact has Treatments on Students' Perception of Biology Teaching?

Table 1: Descriptive Statistics of Mean, Standard Deviation and Gain % of Treatments on Students' Perception of Biology Teaching.

Variable		N	Mean Pre-test	SD	Mean Post-test	SD	Mean Gain	% Mean Gain
Treatment	PCK (Exp.)	414	41.00	10.62	72.61	10.65	31.61	77.10
	Control	204	42.26	8.26	44.21	8.11	1.95	4.61

Table 1 shows that the mean score of the control group ($\bar{X}$ =42.26, SD=8.26) before the treatment is greater than that of the treatment group ($\bar{X}$ = 41.00, SD=10.62). After they are all exposed to treatment the mean score of students exposed to Pedagogical Content Knowledge Instructional Strategy (PCK) (the experimental group) ($\bar{X}$ =72.61), with a percentage mean gain of $\bar{X}$ =77.10 is greater than the mean post-test score of the control group ($\bar{X}$ =44.21), with percentage mean gain of $\bar{X}$ =4.61, in students' perception of biology teaching. This implies that the Students in the experimental group performed better than those in the control group.

Research Question 2

To What Extent Will Treatments Affect Students' Perception of Biology Teaching Based on Gender?

Table 2: Descriptive Statistics of Mean, Standard Deviation and Gain % of Treatments on Students' Perception of Biology Teaching Based on Gender in Experimental and Control Groups.

Gender	N	Mean Pre-test	SD	Mean Post-test	SD	Mean Gain	% Mean Gain
Male (Exp.)	207	40.71	10.64	72.39	10.61	31.68	77.82
Female (Cont.)	207	41.28	10.62	72.84	10.69	31.56	76.21
Male (Cont.)	117	42.10	8.78	44.15	8.66	2.05	4.87
Female (Cont.)	87	42.41	7.54	44.30	7.35	1.89	4.46

Table 2 indicates that the percentage mean gain ($\bar{X}$ =77.82%) of the male students is higher than that of the female ($\bar{X}$ =76.21%) after exposure to experimental treatment. The table also shows that both male and female students in the experimental group performed better than their counterpart in the control group. This indicates that the male students performed better than the female students, however, whether the difference is significant or not will be determined later.

Hypothesis 1

There is no Significant Difference in Students' Perception of Biology Teaching between the Experimental and Control Groups after Treatment.

Table 3: T-test of Students' Perception of Biology Teaching between the Experimental and Control Groups

Treatment	N	Mean	SD	Df	t-value	Sig.	Cohen's d
PCK (Experimental)	414	72.61	10.64	616	33.61	0.00	1.71
Conventional (Control)	204	44.21	8.11				

Significant at p<0.05

Table 3 indicates that there is a significant difference in students' perception of biology teaching between the experimental group taught with the PCK instructional strategy and the control group taught with the conventional lecture strategy (t=33.61, df: 616, p<0.05). This means that the null hypothesis is rejected. This suggests that there is a significant difference in students' perception of biology teaching between the experimental and the control groups. The students taught with PCK instructional strategy have a better perception of biology teaching than those taught with conventional lecture strategy. The PCK instructional strategy had a great effect on students' perception of biology teaching. Cohen's d was used to determine the effect size of the treatment and it shows a value of 1.71, which indicates a great effect (Cohen, 1992).

Hypothesis 2

There is no Significant Difference between Male and Female Students' Perception of Biology Teaching after Exposure to Experimental Treatment.

Table 4: T-test of Students' Perception of Biology Teaching Based on Gender in Experimental Group

Gender	N	Mean	SD	Df	t-value	Sig.
Male	207	72.39	10.61	41	-0.43	0.67
Female	207	72.84	10.69			

Significant at p<0.05

Table 4: shows that no significant difference exists between male and female students' perception of biology teaching after exposure to experimental treatment (t= -0.43, df: 412, p > 0.05). It can be inferred that gender had no effect on students' perception of biology teaching. This implies that the PCK instructional strategy benefitted equally both male and female students with regard to their perception of biology teaching. This signifies that the null hypothesis is not rejected.

Hypothesis 3

There are no Significant Interaction Effects of Treatments and Gender on Students' Perception of Biology Teaching

Table 5: Interaction Effects of Treatment and Gender on Students' Perception of Biology teaching

Sources of variation	Sum of squares	Df	Mean Square	F	Sig.	Partial Eta squared
Corrected model	118860.378[a]	8	14857.547	175.682	.000	.698
Intercept	62664.556	1	62664.556	740.941	.000	.549
Covariate (pretest scores)	6672.918	1	6672.918	78.903	.000	.115
Treatment*Gender	6.389	1	6.389	.076	.784	.000
Error	51503.656	609	84.571			
Total	2641763.000	618				
Corrected Total		617				

a. R Squared =.698 (Adjusted R Squared =.694)

Significant at p<0.05

Furthermore, Table 5: reveals that there are no significant interaction effects of treatment and gender, treatment and class type and gender and class type on students' perception of biology teaching (F =.076, p > 0.05). The null hypotheses of the interaction effects of treatment and gender on students' perception of biology teaching are not rejected.

VI. DISCUSSION

Based on the findings of the study, students in the experimental group taught with PCK instructional strategy have a better and higher perception of biology teaching than those in the control group taught with the conventional lecture strategy. The study indicates that PCK instructional strategy significantly enhanced students' perception of biology teaching. This is because the teachers exhibited adequate knowledge of students' background and the different learning styles/difficulties involved more senses, more instructional materials and strategies in classroom teaching. The students exhibited high perception in many areas among which are: *'My biology teacher has a great knowledge of biology; he teaches clearly and comprehensibly; knows how to attract students' attention to the lesson; uses variety of teaching methods and instructional materials in teaching biology; makes adequate preparation for her lessons; controls what and how we learn* among others. Positive perception of students in biology teaching enhances their achievement in biology. This is in line with the assertion made by Fraser (1998) that there is a close relationship between students' perception of their classroom learning and their success. Also in line with the assertion, Ampadu (2012) in a study on students' perceptions of their teachers' teaching of mathematics discovered that the students' perceptions of their teachers' teaching vary as the results established that both teacher-centred and student-centred teaching approaches were used by mathematics teachers. They agreed that the teachers' actions and inactions impact positively or negatively on their learning experiences as majority of the respondents reported that their learning experiences were to a larger extent controlled by that teacher. Majority of the students indicated that their teachers normally tell them which questions to solve and which methods to use. Contrarily, Onwuocha and Nwakonobi (2009) in a similar study discovered that students perceived their biology teachers mostly as leaders in the classroom, admonishing and strict. They did not perceive their teachers as helpful/friendly allowing responsibility and freedom. The students manifested negative feelings about their biology lessons and teaching.

Students' perception of biology teaching is not gender-sensitive. Male and female students taught with PCK instructional strategy exhibited better perception of biology teaching than their counterparts taught with conventional lecture strategy. The strategy is gender-friendly. There is no significant difference between male and female students' perception of biology teaching after exposure to experimental treatment. This implies that gender had no effect on students' perception of biology teaching. The PCK instructional strategy was beneficial to both male and female students with regard to their perception of biology teaching. This finding is not in agreement with the investigation done by Wolter, Lundeberg, Kang and Herreid (2011) where they reported that the female and non-science students were generally positive toward the use of both clickers and cases. Female students had more positive opinions of clickers, and were more comfortable adopting it than the male students, although effect sizes were small indicating that gender accounted for only half a percent of variance. In the same vein Bernardo, Limjap, Prudente and Roleda (2008) investigated students' perceptions of science classes in the Philippines and reported that the female students perceived more student-centred pedagogies compared to their male counterparts.

Contrary to the above reports Gömleksiz (2012) in another study reported that there were statistically significant differences observed in the perception of students based on the gender of the students. Obviously, male students considered learning science and technology more necessary and important than female students. They also found learning environment and teaching strategies more sufficient and effective than females did. Male students were not satisfied with what the teachers practiced in science classrooms.

VII. CONCLUSION

Pedagogical Content Knowledge Instructional Strategy enhanced students' perception of biology teaching. It was gender friendly. This is a strong indication that both male and female students benefited equally. Thus, it can be concluded that Pedagogical Content Knowledge instructional strategy is effective in changing students' perception of biology teaching and this is an indication of the potency of the intervention treatment. From the study the following recommendations are made:

- Teacher educators should introduce PCK as part of courses in methodology at colleges of education and faculties of education in universities
- Biology teachers should use student centred instructional strategies such as PCK Instructional strategy among others such that students would view biology teaching in a positive way and by extension develop more positive attitude towards the subject.
- Biology textbook writers should adopt the ideas based on Pedagogical Content Knowledge Instructional Strategy in writing biology textbooks at senior secondary school to improve the way students perceive the teaching of the subject.

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