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THE LIKELY IMPLICATIONS OF ACTIVE LEARNING IN PHYSICS THROUGH PEER INSTRUCTION (PI) IN NIGERIAN SCHOOLS

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ABSTRACT
Research studies show that teachers' method of teaching causes poor students' academic performance in physics.PI is a research-based pedagogy for teaching large introductory science courses developed to improve students' academic performance in physics. PI is considered for solving the problem of poor academic performance in physics because it has some common elements with authentic learning instruction. The article considered some likely implications of implementing this pedagogy in physics class for both the students and the teachers. It was concluded that, implementing PI in physics class need teachers who are effective and have adequate pedagogical content knowledge (PCK).

Keywords: Academic performance, authentic learning, peer instruction, method of teaching, PCK.

1. INTRODUCTION

Students' academic performance in physics in Nigerian schools is not encouraging as indicated by research studies. Reasons for this poor performance is due to many factors. One of these factors is teachers' method of teaching as reviewed in this article. The way most teachers in Nigeria teach physics does not encourage learning that is authentic but give room for rote learning. Many physics students, even those considered to be brilliant, hardly could make the connection between what he/she learned in the class and the real-world situation. Any learning that cannot make the connection between concepts learned in the classroom and the real-world problem is not authentic. If the academic performance of students will improve and be able to function in today's world of technology, it must be through an authentic learning experience. This article is looking at the PI as a pedagogy that could produce authentic learning experience because it has many of the elements of authentic learning instruction.

There are nine elements of the authentic learning (Herrington and Oliver, 2000) of which close analysis reveals that five of the elements are in PI. The interpersonal relationship in PI is very high; there is a collaboration between student and student and also between student and the teacher. Students worked in groups; students present their points in an argument among themselves, and the teacher only acts as a facilitator, not as a provider of information. Also, the assessment in PI is done as classroom activity is ongoing not in the form of class test.

It is a method of teaching introduced to teach introductory physics in 1991 at the Harvard University. Many teachers have adopted the method in many countries and found it effective even for other subjects. However, PI is still a new method for teachers in most African countries including Nigeria.

2. PEER INSTRUCTION (PI)

Peer Instruction (PI) is a research-based pedagogy for teaching large introductory science courses (Fagen, and Mazur,2003).It is a method created to help make lectures more interactive and to get students intellectually engaged with what is going on. It has been tested in many classes and found to be effective for improving students' performance and also used to identify student difficult areas. PI has been used in different subjects in many countries. Peer Instruction is still a new method of teaching for many teachers in many countries because of its unique feature of *ConcepTest*.

Peer Instruction is an instructional strategy for engaging students during class through a structured questioning process that involves every student(Crouch, Watkins, Fagen, and Mazur, 2007). Peer instruction is a cooperative learning technique that promotes critical thinking, problem-solving, and decision-making skills(Rao and DiCarlo, 2000).Peer Instruction (PI) is an interactive approach that was designed to improve the learning process(Rosenberg, Lorenzo, and Mazur, 2006). This method, have the advantage of engaging the student and making the lecture more interesting to students. It also has the tremendous importance of giving the lecturers significant feedback about where the class is and what it knows.

PI is more efficient at developing students' conceptual understanding than traditional lecture-based instruction (Lasry, Mazur, and Watkins, 2008).PI improve conceptual learning and traditional problem-solving skills (Lasry, Mazur, and Watkins, 2008).PI is not a rejection of the lecture method, but a supplement that can help in engaging students who have different learning styles (Rosenberg, Lorenzo, and Mazur, 2006).

The main goal of PI is to engage actively pupils in the lecture room and allow their attentions focused on the underlying concepts. Instead of using textbooks or lecture notes, lectures consist of short presentations on the main points, each followed by a *ConcepTest*. These are short conceptual questions typically posed in a multiple-choice format on the subject being taught.

Research studies show that teachers' method of teaching is a key factor for consideration in the teaching and learning. Thus, universities are developing new learning technologies to facilitate improvement in students' learning (Concannon, Flynn and Campbell, 2005). By so doing, Peer Instruction was used to teach an introductory course in the Harvard University.

Many educators appreciated the effectiveness of this method for improving students' conceptual understanding and discovered difficult concepts for students. In the light of this, many countries have adopted PI even to teach different subjects. However, many countries have not been using PI, especially developing countries of Africa. The table below shows countries and number of instructors that had used PI in schools 12years after its introduction in 1991.

Table 2: countries that had used PI

s/n	Country of instructor	Count
1	USA	320
2	Canada	20
3	Australia	11
4	Belgium	3
5	The Netherland	3
6	Spain	3
7	Sweden	3
8	Colombia	2
9	Hong Kong	2
10	Scotland	2
11	Other	12

Source: Fagen, andMazur (2003).

PI and authentic learning have some features in common. These shared characteristics are critical because it makes PI different from ordinary lecture method.

3. AUTHENTIC LEARNING

Authentic learning is described as a learning through the applying of knowledge to real-life contexts and situations (Rule, 2006).Authentic learning is different educational and instructional techniques focused on connecting what students are taught in school to real-world issues, problems, and applications (Hidden curriculum, 2014). Students are actively working, participating in discussions, hunting for information, and enjoying the entire process of authentic learning (Mims, 2003). Authentic learning activities are designed to give students 'real-world' experiences. Authentic learning should be an inquiry into the nature that enables students to develop knowledge and skill for a successful learning (Barron and Chen, 2008).It is a learning that provides students with the opportunity to learn for themselves in a controlled environment where the teacher can help and guide students who are experiencing difficulty (Schoffstall, and Gaddis, 2007).

Authentic learning is a learning by doing. It is an active learning where students are not passive. It is an inquiry method of learning. Observation shows that this learning is paramount for developing critical thinking skills and developing the scientific contents (Apedoe, Walker and Reeves, 2006). It is a process of asking meaningful questions, finding information, drawing conclusions, and reflecting on possible solutions (Milson, 2002).In this learning, students are allowed to direct their investigative skills to complete all scientific processes like data gathering, analysis, hypothesizing, observation and experimenting(Keselman, 2003).

According to Herrington, and Oliver(2000) the following are the elements of learning that is authentic, and that help students to achieve the best:

- Authentic Contexts
- Authentic activities
- Expert performances
- Multiple roles and perspectives
- Reflection
- Articulation
- Coaching and scaffolding
- Authentic assessment (p. 4)

A personal observation as a physics educator reveals that classroom learning of physics in most of our schools lacks the elements above. Therefore, students' academic performance in physics is continuously poor.

The traditional lecture method that is common in classes in Nigerian schools (Afurobi, Izuagba, Obiefuna and Ifegbo, 2015) is no longer effective because it cannot produce what is called the authentic learning experience. This method at best can lead students to rote learning. Most students in Nigeria,today, are unable to connect classroom experience to the real-world problems because they learned to memorize. They learned to forget very easily because they have not actively participated in the class during the lecture. The authentic learning experience is the best learning that is appropriate for the present world of science and technology. The next discussion is students' academic performance in physics in Nigerian schools.

STUDENTS' ACADEMIC PERFORMANCE IN PHYSICS

Studies have shown that students' academic performance in physics is usually poor in schools in Nigeria. The poor performance is not only limited to secondary schools.Stephen (2010) observed that the poor performance of students in physics both at secondary and post-secondary in Nigeria has been worrisome to everyone. According to Dupe(2013), students' poor performances in physics in public examinations are discouraging.

The achievement of students in physics has been worrisome to the generality of the people most especially physics educators and parents (Folashade, and Akinbobola, 2009)

Physics has been seen as a course where students' performance has not been encouraging. It is common to witness a general failure in public examinations like West African Senior School Certificate Examination (WASSCE) and National Examination Council (NECO) in physics in Nigeria (Erinosho, 2013). Students at the secondary school level of education are still performing poorly in physics despite all the government is doing to improve education standard (Shamim, Rashid, and Rashid, 2013).

Physics educators and scholars are not satisfied with students' academic performance in physics. According to Josiah (2012), physics results in most certified examinations like West African Examination Council (WAEC) were not satisfactory. The situation is worrisome to both teachers, parents, and all stakeholders in education. Thomas, and Israel(2012) made it very clear that there has been a drastic reduction in the students' academic performance in physics in Nigeria in the past decades.

Studies show that teachers' strategies or methods of teaching are one of the causes of poor students' academic performance in physics. It has been observed by Malcolm, and Wells (1994)that the effectiveness of physics instruction depends on the pedagogical expertise of the teacher. It indicates that, even when a teacher is using an excellent method of teaching that he or she is not familiar with, students may still not learn as it should be. The teacher is expected to make students actively involved in the classroom because observation shows that active learning stimulate inquiry (McCarthy, and Anderson, 2000)

However, research studies show that traditional lecture approach still dominates teaching in most post-secondary schools (Deslauriers, Schelew and Wieman, 2011).The universities underscore the importance of a proper method of teaching by spending heavily on learning technologies to facilitate improvement in students' learning (Concannon, Flynn, and Campbell, 2005).

Wambugu, Changeiywo and Ndiritu(2013) viewed strategies in teachers' teaching as an important cause of pupils' poor performance in physics. Watkins, and Mazur (2013) attributed failure to science to poor teaching pedagogy.

Crouch, Watkins, Fagen, and Mazur (2007) posited that traditionally taught courses do little to improve students' understanding of the central concepts of physics. Research shows that teaching method like the traditional lecture method commonly used does not help students to acquire sufficient functional understanding of physics (Bernhard et al., 2007). Many concepts are difficult for students to learn, but this might not be known to the teacher early enough until the end of the term or semester when the results are released. There is the need for feedback in every lesson or lecture to identify difficult areas.It prepares the teacher for an immediate remedial action.

To be able to solve this problem, it is imperative the paradigm of teaching and learning must completely change in physics. It must be an activity based where students have full opportunity to interact and collaborate with one another. That is why we have to look at PI and authentic learning as related to students' academic performance.

4. PEER INSTRUCTION, AUTHENTIC LEARNING, AND STUDENTS' ACADEMIC PERFORMANCE

Peer Instruction ensures students are engaged during class through activities that require each student applying the core concepts that are presented after that they explain those concepts to their fellow students. It is different from the usual practice of asking informal questions during a traditional lecture, which typically engages only a few highly motivated students.

PI involves every student in the class through a more structured questioning process. PI provides solid conceptual background that allows students to be more efficient in the problem-solving (Lasry, Mazur, and Watkins, 2008).

The central focus of authentic learning is to discourage rote learning and encourage learning by interaction so that students can apply classroom knowledge to real - world situations. The strength of PI to solve poor academic performance lies in the following:

- High interpersonal relationship between student and student and between student and the teacher;

- Collaboration between student and student and also between student and the teacher;
- Students working together in groups;
- Students present their points through argument between them;
- The teacher only acts as a facilitator, not as a provider of information; and
- Students are assessed during class activity, not in the form of class test.

These are elements of authentic learning that are also found in peer instruction as earlier mentioned in this review.

Authentic learning involves using instructional techniques that focus on connecting what students learned in school to real-world issues and problems. It is precisely what the PI is all about, pose questions using concepTests and allow students to discuss their answers together. Research studies have indicated that PI improves both conceptual and problem-solving skills of physics students (Watkins, and Mazur, 2013).

According to (Turpen, and Finkelstein, 2010), Mazur describes the process of PI as follows:

1. The question posed through *ConcepTest*
2. Students are given time to think
3. Students record or report individual answers
4. Neighboring students discussed their answers
5. Students record or report revised answers
6. Feedback to teacher: Tally of answers
7. Explanation of the correct answers

Peer Instruction (PI) is unique and different from all other cooperative learning because of the use of *ConcepTests.* The use of Concept Inventory such as the Force Concept Inventory (FCI) for both pre- and post-test assessment is only for PI and cannot be employed in another method of teaching successfully. The use of PI as a pedagogy of teaching in physics has some implications for both the teachers and the students.

5. The implications

From this review, literature indicates that PI is an interactive pedagogy aimed at improving the conceptual and problem-solving skill of physics students. PI is a good teaching strategy that does not support rote learning but active learning. This article has many implications for both the physics teacher and student. These implications are discussed below.

Through PI students' academic performance could be improved tremendously and also be able to help physics students connect classroom learning with real-world problems. Students' performance is improved when the teacher employed a teaching method that provide equal opportunity for all learners (Wambugu, Changeiywo and Ndiritu, 2013). PI is a teaching pedagogy that provides learners with equal opportunity in the class, unlike the lecture method where only the brilliant students dominate the class.

The physics class is for students of different learning styles. It is therefore very important for the teachers to find a method of teaching that can meet the need of these categories of students (Al-Rawi, 2013). PI can address the needs of all the students because no student is supposed to be passive. The slow learners have the opportunity of learning from his or her peer in a way that is convenient for them.

C*oncepTest* is the cornerstone of the PI, and every physics teacher should be able to prepare a valid *ConcepTest*. Construction of *ConcepTest* requires physics teacher's expertise idea; this idea evolved as the teacher employs PI. Teachers who are lazy and ineffective cannot use PI because, to construct valid *ConcepTests* requires adequate content knowledge of physics. Therefore, the implication of using PI is to have physics teachers with adequate content knowledge.

A teacher who would implement PI in physics class must be very sound in physics content knowledge and be able to impart the knowledge very well. This mean, such teacher must have adequate pedagogical content knowledge (PCK), otherwise, he or she may lose the control of the class. The loss of control by the teacher may lead to a noisy environment, and the students may not gain much. The implication is that

adequate PCK is crucial for a teacher to be effective in implementing PI. According to Aina and Olanipekun (2015), self-efficacy and PCK are important constructs that help a teacher to succeed in a teaching profession.

The implication of teacher self-efficacy is equally germane to the implementation of PI. It is the beliefs a teacher has about his or her ability to accomplish a specific teaching task (Lunenburg, 2011). Teachers' self – efficacy is the set of beliefs a teacher holds regarding his or her abilities and competencies to teach and influence student behaviour and achievement regardless of outside influences or obstacle (Steele, 2010). From the foregoing, if a teacher self-efficacy is not high he or she would not be able to implement PI in a physics class.

PI promote teacher effectiveness in the class. Teachers who got feedback from the students about his or her learning will ultimately be more effective. According to Aina, Olanipekun and Garuba (2015), teacher effectiveness is very important to students' academic performance in any subject. Aina (2014) has once observed that teachers' teaching pedagogy is a serious factor that influence teacher's effectiveness. According to Aina and Adedo (2013), teachers' poor method of teaching science greatly contributed to the poor performance and enrollment in science in Nigerian schools.

6. CONCLUSION

Peer Instruction (PI) is a cooperative learning technique that was developed to engage students in physics class actively. It has some common elements with an authentic learning experience that makes it better than the traditional lecture method. Implementing PI in physics class has some implications for both the students and the teachers. For a teacher to be able to implement PI successfully in physics class, such teacher should possessed adequate PCK.

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