Teaching Conceptions of Inquiry-based Learning among Nigerian Secondary School Physics Teachers

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Absract--- *Inquiry-based learning (IBL) is gaining popularity in science education worldwide. Unfortunately, many teachers are yet to comprehend its pedagogical modulus operandi especially in West Africa and Nigeria, in particular, maybe due to their teaching conception that is still inclined towards teacher-centred paradigm. This paper is targeted at finding out the teachers' teaching conception towards IBL in secondary schools in Kebbi State, Nigeria. Promoting Inquiry-based learning in Science and Mathematics (PRIMAS) questionnaire was administered to a sample of 85 Physics secondary school teachers in Kebbi State. Discriptive statistics was used to arrived at a mean value of 2.74 which represent the value of the physics teachers conception. Inadequate knowledge of IBL, teachers' difficulty to apply the method, current practices (national curriculum and lack of adequate instructional materials) were found to be some of the respondents' major conception. Professional development programs, curriculum review and IBL teachers' welfare were some of the suggestions offered to improve the teaching conception towards IBL.*

Keywords--- *Nigerian Secondary School Physics Teachers, Teaching Conceptions and Inquiry-based Learning.*

I. INTRODUCTION

There are two main approaches towards teaching and learning: namely, traditional and constructivist [1,2]. Teaching and learning approaches are classified by some authors as teacher-centred/content-oriented or student-centred/learning-oriented [1,3]. In a typical traditional approach, the teacher-student interface is limited, knowledge transfer is only one-way from the teacher to the student, the teacher is considered as the repertoire of knowledge and it includes the use of teacher-centred teaching strategies. The traditional approach takes the students as passive recipients while the teacher as the alpha and omega of knowledge, and. This approach particularly emphasizes the acquisition of knowledge from the teacher, textbook and the chalkboard [2,5]. In traditional learning and teaching, environments are encouraged by the use of such factors as reward, punishment, repetition, retention, memorization and so on. An environment is created where everything is determined, presented and controlled by the teacher [5].

Constructivism is a learning approach that requires students to acquire the necessary knowledge on their own, as part of active learning that the teacher establishes and under the close supervision of the teacher, and in which they construct and interpret this knowledge based on their previous experiences [6-9]. The paradigm comes from piaget's, Dewey's, Vygotsky's and Von Glassersfeld's works [10]. According to [9], the concepts that form the foundation of constructivism are that the learner should find and transform complex knowledge individually to integrate what is learned within himself. Fensham [7] is of the view that the constructivist concept emphasizes the creation of active

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learning environments that encourage critical thinking, research and cooperation, for instance, the Inquiry-based learning (IBL). IBL approaches acquisition have been in the increase in many developed countries of the world, this because of its significant influence to poster active and constructive learning. It is a teaching and learning methodology that positions the questions, thoughts and experiences of students at the forefront of the learning experience. IBL builds on constructivist learning theories in which students develop new ideas or concepts based on their experience and previous knowledge [11]. IBL is also a student-centered approach that allows participants to build on their previous knowledge and experience in the context of their work. Boyd [12] viewed IBL as a rather structured and directed practice, especially at lower levels, where the instructor can ask and direct him through independent research to solve the problem. In IBL, the student is responsible for building its own meaning and understanding through learning activities. According to [13] throughout the process, the educators play a leading role, building a culture where ideas are respected, tested, redefined, and seen as improvable, and where children move from being asked to understand and ask questions.

Students require specific skills to actively participate in the inquiry process. These include the ability to ask questions, then to try, interpret, communicate, reflect and apply. This procedure helps students to apply and use skills such as analysis and synthesis. Inquiry skills leads to promoting curiosity, critical thinking and self-reliant thinking. With this expertise, students can develop and diagnose self-directed research, formulate theories, define variables, collect data, record, and ultimately interpret the findings and communicate them. [14]. National Research Council [15] identified that there are three types of IBL, structured, guided and open inquiry-based learning and the usage depend on the specific needs in the science classroom. Comprehension of the different aspects of research will allow educators to better meet the needs of all science students through specific teaching and learning experiences. IBL studies have shown that teachers are responsible for finding creative ways to present the students with ideas and topics of interest and interest or promise in terms of opportunities for students to engage in a sustained inquiry of their own [11]. Philippou [16] reported that another task of teachers is to answer the most important issues leading to other questions and to build kernels for further study. However, Sometimes the inquiry starts with a shared experience, rather than a question or concern. Teachers should support the involvement of students in research and encourage them to build meaningful understandings. The type of help students require depends heavily on the type of problem they are having and the experience that students have with IBL. There is no value in providing teachers with the exact support needed to facilitate learning for students.

Inquiry-based Learning (IBL)

In empirical research, the benefits of IBL are well known. Osborne [17] noted that inquiry motivates and encourages interest in science learning affectively. Therefore, IBL was shown to help develop conceptual understanding in science [18]. The development of higher order thinking skills thought such as interpretation, synthesis, critical thinking and assessment will contribute to a scientific inquiry[19]. Research is also a valuable way to understand the essence of science [20,21] and gives an insight into the scientist's world [22]. Despite increasing consensus on the value of inquiry-based education and learning, research has found that many teachers still have a challenge in implementing such pedagogical practice [23]. Numerous studies on IBL have been conducted over the world, for instance, the 12 European partner countries project on IBL pedagogies and practices,

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the project designed a question called the promotion of inquiry-based learning in science and mathematics in 2011[24]. IBL signals a shift from the traditionally-dominated instructor approach to a learner-centered approach. The role of the instructor in a typical passive learning environment is redefined here in several positions that are based on [25] “motivator, guide, innovator, experimenter, researcher, modeller, mentor, diagnostician, collaborator, and learner” p-526).

In Nigeria, IBL's emergence as a necessity for curriculums was a recent development and, thus, there was only limited research in this regard [26]. The research reported in this article is on the interaction between secondary school physics teachers’ conceptions about IBL practice in their classrooms. In Nigeria, a major reform of the education system coincided with the emergence of a new democratic political order from 1992. The reform of the education system in Nigeria has led to substantial improvements. This includes enhanced school enrolment numbers, speedy provision of school infrastructure, fairer allocation of resources, improved educational/learning ratios and the introduction of school nutrition programs [27]. However, State education in places other than federal unity schools is less qualitative with education in other part of the country.. This is despite the fact that the vast majority of school-going children in Nigeria attend the state schools. Factors that limit curricular changes, such as the implementation of the IBL, also tend to be more pronounced in government schools. A particular focus of this research was therefore on the teachers who were teaching at state schools. But what are the Kebbi state physics teachers teaching conceptions of IBL?

Teaching Conceptions

Conceptions of teaching and learning refer to the held beliefs, attitudes, intentions that the teachers have concerning the methods of teaching and learning [1, 28,29]. These beliefs include the meaning of teaching and learning, and the roles played by both teachers and students. Educational research in recent decades has shown convincingly that teaching and learning practices need to adopt a more complex format in which education is not only more or more complex to transfer established knowledge if we want students to improve [30]. However, in order to modify them, teachers’ should take into account knowledge and capabilities of the students, encourage cooperation by means of more dialogue, and encourage metacognition and self-regulation by the students through their own learning in their diverse variants and theater interpretations [1,29]. These basic assumptions about the constructivist approach have undoubtedly influenced the educational policies of the various countries to bring about the changes our society needs. Nevertheless, the studies of teaching and learning approaches continue to show that more or less traditional teaching practices are primarily guided by the transfer of knowledge by the teacher to pupils. Most of the African countries and other less developed countries of the world believed that the knowledge transmission domain form of teaching and learning is more rewarding and beneficial [31,32].

Gow & Kember [1] has established a relationship between teachers teaching conceptions and student approaches to learning. In a study conducted by [33], revealed a strong relationship between teaching conceptions and teaching approaches. In another study of [34] discovered a considerably negative relationship between constructivist teacher principles and student control ideas and between conventional teaching-learning perceptions and philosophies of student control. and a significant positive relationship is formed. Similarly, [35] in his study on the relationship

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between teachers' educational philosophy beliefs and their teaching-learning conceptions found a relationship between constructivist teaching-learning conception and progressivism, existentialism, and reconstructionist; and also between traditional teaching-learning conception and essentialism and perennialism. Furthermore, the study of [30] found a significant impact of the student-centred learning over the traditional form in engineering education. The importance of supporting the autonomy and individual differences in students during the course of the study are emphasized by new approaches for learning. Teaching has to be based on the individual differences of the students. It can be claimed that the experience gained from students' cultures constitutes an important aspect of the individual differences expressed in the educational environment.

Statement of the Problem

The acquisition of scientific skills is a requirement for technological development of any nation, there is a need to improve students' science-based knowledge and enthusiasm to learn the subject. Physics as the backbone for all scientific and technological advancement needs erstwhile attention. Uill now, Nigeria recorded a deplorable state of secondary school education with poor performance in science, especially physics. This poor performance in physics may be attributed to inappropriate teaching method and approaches used by physics teachers and lack of teaching resources among others. There is the need for a more pragmatic teaching approach such as IBL that have been tested by many countries in the world perhaps Nigeria will be safe from the current trend of failure in physics. It is on this ground that this study is out to examine the physics teachers' conceptions of physics teaching through IBL. The study is guided by one general question: How are the teaching conceptions of physics teachers who practice IBL in teaching physics in Kebbi state high schools?

II. METHODOLOGY

The study adopted a descriptive research design. This is because it involved drawing appropriate information from the existing situation and the beliefs of teachers in relation to the use of inquiry-based learning approach. The population of the study comprises of all Kebbi State secondary school Physics Teachers. which comprises of 121 physics teachers. 85 physics teachers formed the sample [35]. Using simple random technique 85 physics teachers will be selected to participate in the study. All the 85 sampled physics teachers will be served the survey questionnaire. In collecting the data, the PRIMAS was used.a questionnaire named The instrument was firstly piloted with a group of five physics teachers, who did not form a part of the sample selected. The teachers in the pilot study were asked to identify unclear items that they consider as being vague.

The questionnaire was introduced in the original format and readability concerns have been posed. The questionnaire contains statements to be answered on an Likert scale of four points ranging from 1 (strongly disagree) to 4 (strongly agree). The items are selected based on constructs on inquiry-based learning.. The following three constructs are of interest the purposes of these research: teachers' beliefs and attitudes about IBL; teachers' difficulty in the enactment of IBL; and teachers' current practices regarding IBL. Inquiry-based learning was briefly introduced at the beginning of the instrument. The purpose of which is to ensure that respondents have a common understanding of the IBL terminology used. Here, IBL is described as "a student-centred way of learning content, strategies and self-directed learning skills. Students develop their questions to examine; engage in self-directed

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inquiry (diagnosing problems – formulating a hypothesis – identifying variables – collecting data – documenting their work – interpreting and communicating results) – collaborate" [24]. The PRIMAS item statements for the constructs, teachers' beliefs and attitudes about IBL, teachers' difficulty in the enactment of IBL, and teachers' current IBL practices.

In most part of the questionnaire, the item statements were positively worded. This meant that a higher score for an item (towards strongly agree) suggested the strength of that construct. A few items were negatively formulated, for example, "I see no need to use IBL approaches." In such a case, the items were reverse-scored, where the numerical scoring scale runs in the opposite direction. So, in the above example, strongly disagree would attract a score of 4, and strongly agree with a score of 1. Therefore, from a mean score close to 4 for the construct "teacher beliefs and attitudes," it can be inferred that teachers have a positive belief in and attitude towards inquiry-based learning. Similarly, a high score for the construct "teacher difficulty with inquiry-based learning" highlighted the difficulty teachers encountered with inquiry-based learning. Table 1 provides a brief description of the constructs, the number of items per construct, and number of questions.

Table 1: Table of Construct PRIMAS

Construct	Item number	Total
Teachers beliefs and attitudes about Inquiry-based learning	Section A. 1-9	9
Teachers difficulty in enacting Inquiry-based learning	SectionB.10-23	16
Teachers current practices of Inquiry-based learning	Section C. 24-42	17

III. RESULT AND DISCUSSION

The Physics teachers' responses to the PRIMAS questionnaire were used to conduct a descriptive analysis. The result of the analysis is presented in Table 2.

Table 2: Teaching conceptions of Physics

SN	Teaching conception	N	Min	Max	Mean	Std. Dev
1	Belief and Attitude	85	1.90	3.70	2.91	0.305
2	Teaching Difficulty	85	1.90	3.40	2.77	0.314
3	Current Practice	85	2.00	3.68	2.64	0.257
Average					**2.74**	**0.209**

The result of the analysis on the teaching conceptions of Physics teachers who practice IBL in teaching physics in Kebbi state high schools as presented reveals the responses of Physics teachers on their teaching conceptions measured using the 42 statements. Based on the result of the analysis, the Physics teachers score up to 2.5 and above on all the items indicating that the Physics teachers teaching conceptions is generally moderate. The analysis based on Physics teachers teaching conceptions by dimensions shows that Physics teachers belief and attitude has a mean of 2.91 (SD=0.305) meaning that, teachers belief and attitude on the IBL is moderate, the result on the teaching difficulty showed 2.77 (SD=0.314). Similarly, the result of the Physics teachers current practice 2.64 (SD=0.257). The Physics teachers' conception of IBL on the overall showed that the teachers' conception is general moderate with a mean of 2.74 (SD=0.209).

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A classroom is an active place where many things happen at once. In a manner, not often apparent, cognitive, social, cultural, affective, emotional, motivational and curricular factors assert their influence. To describe a teacher standing in front of 40–50 students explaining phenomenon fails to capture important characteristics of even traditional classrooms. Indeed, a teacher cannot teach in such a way that only cognitive information is obtained. It is much more complex than the simple sharing of information in a classroom. The analysis of the result based on Physics teachers teaching conceptions by dimensions shows that Physics teachers belief and attitude has a mean of 2.91 (SD=0.305) meaning that, teachers belief and attitude on the IBL is moderate. The result is astonishing because it buttressed the fact that Kebbi state physics teachers are flexible in their teaching methods. Their belief and attitude on the traditional teaching approach do not prevent them from embracing an active form of learning like IBL. Likewise, the teachers' belief and attitude on IBL does not prevent them from practising another plausible method of teaching physics. It, therefore, seems that teachers have a fundamental belief in the importance of this approach that is necessary for the implementation of IBL. For instance, [37] found that teachers, who thought that science learning was related to scientific practices based on research, infused their teaching with investigative activities. However, favourable belief does not necessarily lead to the practice of teachers. Cavlazoglu & Carol [38] attested to the fact that the link between belief and practice is apparent. The findings of research on the relationship between Kebbi state Physics teachers' beliefs about inquiry-based learning and their teaching practice coincide with this later trend. The result of the findings also revealed that teaching difficulty is moderate, that the Physics teachers are taking a moderate position in the way they teach using the IBL method. This may be a constraint depriving them of taking a full pledge position. This constraint could only be identified in further study. Other studies on IBL confessed to the fact that IBL teaching is difficult [11, 38-42]. However, the level of difficulty of IBL varies from its conceptions, an in-depth study may be required to quantify the level of difficulty of an individual teacher in an IBL classroom it could also be dependent of the knowledge of IBL itself. Again the result indicated a moderate practice of the method in teaching and learning of physics by Kebbi state physics teachers. This means that the teachers do not use the method so often, the implication is they could identify the plausible contribution of IBL as modular of active learning whose benefits are found to be overwhelming. For instance, the 12 European countries that surveyed IBL using the PRIMAS concluded a remarkable transformation of their students in science and mathematics. The overall conceptions of the physics teachers are not discouraging 2.74 (SD=0.209) it provided a chance for inclination towards the positive aspect of the method.

IV. CONCLUSION

This paper suggested that teachers should not ignore IBL, but rather to accept the IBL framework that is workable for their physics teaching. An approach that would allow for a pedagogical inquiry practice to be followed which would be a negotiation between teachers ' personal convictions about teaching and identified constraining factors on its implementation. Various frameworks have been used to describe the degree of openness or closure of IBL investigation such as the 5E'S, 7E'S and other learning cycles [13,43,44]. Physics teachers should engage themselves through professional development programs that will entice them more of the benefits of IBL. By so doing their conceptions on IBL may be on the increase. IBL is not just learned through a part of an undergraduate course but a course of its own.

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