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Investigating the Perception of Senior Secondary School Students on the Role of Classroom Engagement in Mathematics Problem Solving

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Abstract: This study was designed to investigate the perception of students on the role of classroom engagement in student's problem solving in mathematics. Specifically, the study investigated the perception of 6 students taught by 4 mathematics teachers in 2 secondary schools in Nigeria for a period of 2 years. Two research objectives were developed to guide the study. Research journal and video recordings were used to document the focus group discussions and classroom observations. The findings of the study suggested that the mathematics teachers made positive effort to use the engagement strategy as a tool to increase students problem solving abilities during mathematics classroom instruction. In addition, the result of the study suggested a positive increase in students' problem-solving skills. This was evident in students' engagement in collaboration, participation, increase in positive relationships that existed between students and their teachers. The study also suggested that the mathematics teachers created positive classroom atmosphere for students' participation in classrooms problem solving. It also suggests that teachers provided inclusive support for students' problem solving in mathematics and provided evidence of general traditional teacher centred learning in mathematics as opposed to student-centred learning among the students.

Keywords*: Classroom practice, collaborative work, engagement, mathematics, problem solving. secondary school students,*

Introduction

Mathematics is a fundamental tool used in human thoughts and logic. It is also an integral part of man's attempts to understand and manipulate the world around him and its galaxies (National Curriculum Framework, NCF from now, 2005). Every society believes that mathematics is the backbone of science and technology. This is because of its indispensability to many fields of life (Kusure & Basira, 2012). It is also believed that mathematics contributes a lot to the important roles of man's daily life in developing strategies to control his environment, therefore, it cannot be excluded from daily activities (Colgan, 2014; Mpofu & Mpofu, 2019; Tun, 2015). Studies conducted by Mpofu and Mpofu suggest that mathematics has provided the human race with an effective way of building mental discipline and use of logical reasonings and mental rigor to find solution to its problems **(**Mpofu & Mpofu, 2019). In addition to the view of Mpofu and Mpofu (2019) and the NCF (2005), mathematics knowledge plays an important and crucial role in helping man understand the content of other school subjects such as the sciences, the arts and the social sciences.

Students' performance in mathematics in Nigeria over the years at all levels of education has however not been

encouraging (Bature & Bature, 2006). Kusure and Basira (2012) and Mpofu and Mpofu (2019)' empirical research also suggests a similar concern in Zimbabwe. The poor performance of students in mathematics particularly in national and standard examinations has generated a lot of debates among Nigeria mathematics educators and researchers. There is no empirical research confirming an exact reason for students' poor unsatisfactory performance in mathematics.

However, key research indicators suggest that students' poor performance in mathematics can be associated to mathematics teachers' techniques. For example, Kusure and Basira (2019) and Bature and Bature (2006) were of the view that, the incompetence of most mathematics teachers is of great concern. Other authors suggest different reasons: for example, poor teachers' background knowledge in mathematics (Mupa, 2015), poor mathematics teaching pedagogies (Kusure & Basira, 2012) and the quality of mathematics teachers employed to teach mathematics in schools (Nagy, 2019; Obomanu and Adaramola, 2011).

Adeyemin (2008) also identified large class size as one of the problems (factors) affecting teaching of mathematics in schools. Johnson (2004) and Nwagbo (1999) were of the view that, as a result of quality teacher education in Nigerian universities, some mathematics teachers justify their actions by claiming that given the fact that they were not taught mathematics in university using the inquiry and collaborative student-centred approaches it is difficult for them to implement any form of constructivist epistemology. Osuafor (1999) in his study observed that a considerable percentage of mathematics teachers have limited knowledge on the strategies to effectively utilise innovative mathematics instructional strategies such as problem solving, cooperative learning, problem-based learning and many other constructivist learning strategies for their students.

Consequently, many concerns and questions are raised daily on the quality of mathematics teacher education programs in Nigeria and how well mathematics teachers are prepared to teach mathematics after graduation (Bature 2014). Nagy (2019) was of the view that the dearth of qualified mathematics teachers has resulted in recruiting teachers with no positive qualification in mathematics to teach mathematics classes in many countries and not only in countries like Nigeria. Though countries like Australia are tightening up their regulation and compliance for all mathematics teachers to ensure consistency of delivery and student achievement, we still have evidence of teachers from other areas of specialisations teaching mathematics (Nagy, 2019).

The role of mathematics teachers at all level of education in Nigeria is reflected in the national policy on education (FRN, 2006). It declares that "*no education can rise above the quality of its teachers*". It is therefore important to remember that competence, ability, resourcefulness and ingenuity to effectively and efficiently utilize appropriate mathematics language Bature and Igwe (2010), methodology and availability of instructional materials and strategies Eso (1998), are the key basic ingredients that should be seen in effective efficient mathematics teachers. This suggest that a mathematics teacher is a significant figure or factor to effective teaching and learning of mathematics FGN (2006) and no matter the amount of resources invested into the development of mathematics teachers, improper preparation and motivation of mathematics teachers could pose a negative impact in a country's scientific and technological development (Guay, Chanal, Ratelle, Marsh & Boivin, 2010; Nevid, 2013).

Research studies suggest that productive mathematics teachers are believed to be knowledgeable in their subject matter, very organised and well prepared for their classroom instruction and are enthusiastic in their

approach to mathematics classroom instruction (Klegeris, Bahniwal & Hurren, 2013; Skemp, 2006; Bature & Jibrin, 2016; Vondrová & Žalská, 2013). Productive mathematics teachers are those that work to stimulate their students' interest and have the clarity and flexibility of presentation of mathematics ideas, posed positive classroom management and interpersonal traits such as helpfulness, openness and friendliness in their approach to classroom instruction (Choy, 2013; 2014; Vondrová & Žalská, 2013; Yang & Ricks, 2013).

Given that Nigerian mathematics curriculum is designed with the constructivist epistemology in mind (FGN, 2006). Teachers of mathematics are therefore advised to strive to make instruction in mathematics more practical, inquiry based, and collaborative (Bature & Atweh, 2019; 2016; NERDC, 2013). They should also provide opportunities for students to be engaged in problem solving activities during classroom instruction (Adiku, 2008; The National Centre for Educational Achievement (NCEA), 2010; Protheroe, 2007).

However, it is sad to note that, the commonly adopted mathematics classroom instructional strategy in Nigeria is the traditional teacher-centred approach. In these classrooms Nesmith (2008) asserted that mathematics teachers

> "*pay attention to the memorization of facts as well as the ability to follow rules, execute procedures, and plug in formulas… only those students capable of absorbing, accumulating, and regurgitating received items of information in this manner*" (p.1)

are the only students that can excel in traditional mathematics classrooms (Hiebert, 2003). This traditional approach permits the teachersto instruct the students traditionally, meaning the teacher controls all classroom's activities (Abanihe, Ifeoma, John & Tandi, 2010). Kaka (2007) expressed his disappointment stating that thetraditional teacher centred approach has remained unchallenged (Bature & Atweh, 2016). This is in stack difference to the Nigerian National objectives of mathematics as stated in the National Policy on Education (FGN, 2006; 2004).

Research findings also suggests that most mathematics teachers in Nigeria monopolised communication during classroom instruction, dominate classroom discussions, and maintain basic structures that heavily relyon teacher-centred classroom approach (Brophy, 1999; Bature & Jibrin, 2015). In this type of approach, mathematics teachers dominate classroom talk, while students' responsibility is to listen carefully and copy examples given on the chalkboard (Black & Solomon 2008; Solomon 2007; 2008).

Similarly, research results indicate that most mathematics teachers in Nigeria monopolize communication during classroom instruction, dominate classroom discussion, and maintain basic structures that heavily rely on teacher-centred classroom approach (Brophy, 1999; Bature & Jibrin, 2015). In this type of approach, mathematics teachers dominate classroom talk, while students' responsibility is to listen carefully and copy examples given on the chalkboard (Solomon, 2007; 2008; Black & Solomon, 2008). The approach does not give students the opportunity to contribute to classroom discussions Emaikwu (2012), contributing to discourage collaboration, engagements, interactions and effective knowledge constructions as proposed in the constructivist epistemology (Ball, 2003).

With these challenges in the Nigerian mathematics classroom in mind, the development of teachers and the teacher education program, especially at the primary and secondary schools' levels should be made a priority. Therefore, the researchers introduced the concept of

classroom engagement to four mathematics teachers in a two years longitudinal study, with the view of using the concept to reform mathematics classrooms practice in Nigerian Secondary School (Hiebert, 2003). In this research paper the researchers discussed the perception of students on the effectiveness of students' engagement in mathematics problem solving. Specifically, the following research objectives will be used for the study.

1. To investigate the initial perception of students on their engagement in mathematics problem solving.
2. To investigate the perception of students on the role of engagement in mathematics problem solving.

Theoretical Framework.

When the concept of pedagogy is mentioned, it suggests a range of approaches, strategies, skills and competencies teachers, researchers and educators used to organise their ideas (Bristow & Patrick, 2014; Higgins et al, 2015; Jensen et al 2015; UNESCO, 2015). This is believed to be what mathematics teachers and other teachers useas a means to achieving quality classroom instruction. Mathematics educators and researchers in more than 6 decades have made concerted effort in addressing the epistemological and philosophical issues associated with mathematics and mathematics classroom instruction (Bature & Atweh, 2016; Atweh, 2007).

For example, notable mathematics educators and researchers like Ernest (1991), Freudental (1978) and Skemp (1975) view mathematics and mathematics classroom instruction in fallibilistic perspective. Davis, Maher and Nodding (1990) and Glaserfield (1978) view mathematics and mathematics classroom teaching and learning in a constructive process or perspectives. Lave and Wenger (1991) in their study discussed mathematics teaching and learning through what they called "*Situate Knowledge*" relative to communities of practice. The debate on the commensurability of constructivist and socio-cultural epistemologies suggest the philosophical and the epistemological development of mathematics teaching and learning (Lerman, 1996; Steffe & Thompson, 2000; Vander Ark, 2016).

Current research theories and that of mathematics and mathematics education in literature suggest the development of a varieties of teaching techniques and methodologies based on several theoretical underpinnings (Atweh, 2007). For example, there is the use of multi-tiered scale approach used by teachers to express the level of expertise required to achieve measurable students' outcomes during classroom instruction Anderson & Krathwohl (2001) commonly called Bloom Taxonomy (Bloom, 1956). Secondly, the

> *"Howard Gardner's Theory of Multiple Intelligence*" which posits that "*we are not all the same, we do not all have the same kinds of minds, and education works most effectively for most individuals if...human differences are taken seriously"* (Gardner, 1995, p.208).

"The Debono's Thinking Hats" which provides a model to help students think clearly and thoroughly by directing their thinking and attention in one direction at a time (De Bono, 1990). Finally, the Myer-Briggs Personality types which described how to design personality test, can assist students identify significant alternatives (Briggs Myers, McCauley, Quenk & Hammer, 1998).

These teaching techniques and strategies possesses positive characteristics that are interrelated to one another. However, research findings have shown that none of these teaching techniques contains prescriptive teaching tools for teachers and their classroom instructions. Atweh (2007) was of the view that these teaching techniques and strategies or what Atweh (2007) call teaching tools are

used by teachers *for "reflection…, critiquing their own pedagogies…, and to designealternative pedagogies (p. 98).* However, Atweh (2007) and Bature & Atweh (2016) suggested that these models or teaching strategies are content based; they can be used in a variety of subject's areas and at different levels of teaching without dismissing their value for teaching. Atweh (2007) went further to note that educational research based on these tools and epistemologies are built, and are perhaps limited to

> "*Focus more on higher order thinking and intelligence, constructed under the individualistic models of learning…, they don't consider the social dimension of learning…, While some of them might acknowledge individual differences in thinking style and preference to learning, they do not account for the effects of student background and their social context". (p.98)*.

Similarly, there are several other teaching models or frameworks that have been developed by researchers and educators to improve the teaching and learning of mathematics across countries. These models were not specifically for mathematics classroom teaching alone, but for general improvement of teaching across subjects. Prominent among them are the *Critical Mathematics Education*, which revolves around the social and political perspectives of mathematics teaching and learning (Atweh, 2007; Skovsmose, 2005; Valero, 2009). There are also the Montessori pedagogies which assist students progress their learning according to their pace, rhythms and individual capabilities (Montessori, 2003).

Other philosophical and epistemological discoveries that are relevant to improving students engagement and participation in mathematics classroom instruction is the concept of the "Rich Task" inPiggott (2004), he posits that mathematics enrichment program is not simply learning facts and demonstrating skills, but it involves skills, knowledge acquisitions which are precursors, effective understanding and outcomes of a rich driven learning. Ernest (2001) suggested that mathematics enrichment program represent an open and flexible approach to teaching and learning of mathematics and also encourage experimentation and communication.

The introduction of good teaching practices that is new can significantly improve classroom instruction and create classroom atmosphere that encourage student's participation and collaboration. This is supported by the view of Huerta Melchor (2008) who suggested that reform in mathematics classroom instruction in countries like Nigeria is the only way of producing change and its possible to increasing students' participations and learning outcomes in mathematics classrooms. One of these reforms that could be adopted in Nigeria is the introduction of mathematics classrooms that encourage student's engagement in mathematics problems solving (Bature & Jibrin, 2015).

Problem Solving in Mathematics

Studies conducted by Esan (2015) suggest that the commonly used teaching and learning approaches in mathematics in Nigeria and some parts of the developing world is teacher centered. This view of Esan (2015) supports an earlier study by Akala (2000) and Oyanya and Njuguna (1999) who held the view that this teaching strategy is obsolete, ineffective and teacher centred. Problem solving in mathematics is a cognitive process directed at achieving a mathematics goal, where no particular or single solution is obvious to the problem solver (Mayer & Wittrock, 2006). In this scenario, the problem solver sometimes is left to decide on the approach to take in achieving his/her goal or solution and sometimes the mathematics teacher provide some clues or guides leading to the solution. Similarly, problem solving according to Julius, Abdullah and Suhairom, (2018) could also be viewed as a

> *"component of mathematics that is refers to as a goal directed sequence of cognitive, affective and conative operations geared towards finding the unknown for bridging the gap between the present and a goal stated"* (pp. 26, 27).

The major objective in problem solving is to equip the student with strategies and abilities that would endear him/her to confront mathematics problems and solved them on daily basis (James & Adewale, 2015; National Council of Teachers of Mathematics; 2012).

The lack of students understanding in problem-solving techniques in most Nigerian mathematics classrooms is believed by Nigerian educators as the most common reasons for student's poor performance in mathematics and science (James & Adewale, 2015). Studies suggests reasons for these, being that students do not learn how to solve problems, but merely memorize solutions explained by teachers in line with the traditional teacher centred epistemology (Bature & Atweh; 2019; 2016; James & Adewale, 2015; Julius et al, 2018). It has also led to a scenario where the powers of thinking and understanding among students is becoming a case of concerned among Nigerian mathematics educatoras and researchers. This is mostly observed in student's overdependence on their mathematics teachers for almost everything (Bature, Atweh & Treagust, 2016).

In another study, Bature and Atweh (2019) where of the view that, this student's general dependence on their teachers for all their learning needs is becoming emberasing to both the teachers and their students. This is because, that passion, resilience and self-effort that is expected to be seen in students as promoted in the constructivist epistemology is lacking in most Nigerian mathematics students' classrooms (Bature & Atweh, 2019). It is also generally reported by researchers, mathematics educators and teachers that Nigerian students have negative attitude towards mathematics problem solving (Bature & Atweh, 2019; 2016; Esan, 2015; Salman, Yahaya & Adewara, 2011). This view could be attributed to the negative attitude of Nigeria students to mathematics which they have tagged "difficult" and an "abstract subject" (Ajai, Imoko, & Okwu, 2013; Bature &Bature 2005, 2006).

It is generally believed in literature that the effective way to achieving success in mathematics is through the understanding of mathematics problem solving strategies. Mathematicians have always held the belief that problem solving is central to their disciplines because without a problem, there is no mathematics. Therefore, problem solving has played and is playing a central role in the thinking of mathematics educational theories.the National Council of Teachers of Mathematics (NCTM) has been consistently advocating the inculcation of problem-solving activities in all mathematics classroom instruction for over 40 years now. Similarly, the international trend in mathematics teaching and learning has also shoed an increase focus both in research and teaching using the problem-solving epistemology. Mathematics educators, school mathematics teachers, both locally and internationally are becoming increasingly aware that providing problem-solving experiences is critical if students are to be able to use and apply mathematical knowledge in meaningful ways (Wu & Zhang 2006).

In view of these, therefore, the key to achieving effective teaching and learning in mathematics, is the development of problem-solving abilities, strategies and interest in our students (Julius et al, 2018). It is, therefore, pertinent to assert here that problem solving transcends all scientific disciplines and it constitutes an integral part of mathematics program at all levels of education (Esan, 2015 Julius, 2018). Almost everything that an individual does involves problem solving in one way or the other,

because it is directed toward achieving a particular goal (Esan, 2015). This suggest that, creating in student's problem-solving strategies and abilities in mathematics classroom is key to improving students learning and learning outcomes (Bature et al 2016; Bature & Atweh, 2020). The researchers believed that achieving this positive improvement in students learning and learning outcomes can be significantly demonstrated if, mathematics teachers create classrooms environment that encourage students' engagement in problem solving activities.

The Concept of Engagement in Classroom Instruction

The theory of engagement in mathematics classroom could be conceptualised as multi-dimensional (Watts & Goos, 2017). They could be termed behavioural, affective and cognitive in domains (Fredricks, Filsecker, & Lawson, 2016). These could be mapped into a sector of doing, feeling, and thinking. In mathematics, behavioural engagement could be referred to as the extent to which students collaborate, participate, dialogues and engaged into negotiating, debating and critiquing one another's thoughts and understanding during mathematics classroom engagement and or problem solving. This includes the deliberate and the intended enrolments, together with the degree of efforts students employ during mathematics problems solving **(**Bature & Atweh, 2019).

Describing the affective engagement in mathematics problem solving Bature & Atweh (2019) further suggest that effective engagement includes the emotional dimension of interest, support, collaboration and the level of students' enjoyment on concepts under consideration. Effective engagement can be extended to identificating the classroom's culture and the school's culture (Fredricks 2011). Cognitive engagement describes the student's personal investment into the classroom instruction. This will include their self-regulatory strategies and resilience in mathematics problem solving activities (Fredricks 2011). Eccles (2016) in his study view the differences between these three domains of engagement and suggested that they are difficult to perceive, he however asserted that they provide a useful tool for classification of major heuristics elements of fostering effective engagement during mathematics problem solving (Fredricks, et al, 2016; Watts & Goos, 2017).

The student's engagement approach to problem solving in mathematics is new in Nigerian mathematics classroom. Smith (2018) was of the view that students who are profitably and genuinely engaged in mathematics problems solving learn mathematics in a more profitable and productive way. These students are likely to achieve scores above the state's average in complex mathematics tasks (Smith, 2017). Attard (2015) in support of the findings of Eccles (2016) suggested that mathematics engagement of students in problem solving can be observed more productively using the multi-dimensional construct of the three domains (domains: operative, cognitive and affective). This suggest that the union of these domains leads to students feeling good, increasing their thinking ability, and fostera positive learning environment withstudents engaged in profitable mathematics problem solving (Fair Go Team NSW Department of Education and Training, 2006; Fredericks, et al, 2016).

Student Engagement in mathematics can be viewed as students' involvement in mathematics classroom activities and their commitment to learning mathematics concepts and content provided to them by their teachers (Ingram, 2013). The concept of engagement according to Ingram (2013) is viewed as different from the concept of classroom participation. He posited that students' engagement in mathematics classrooms can be achieved during problems solving when mathematics teachers provide their students with positive classroom environment that encourage dialogue, discussions and

collaborations (Bature and Atweh, 2019). Establishing positive pedagogical relationship through the provision of solid foundation for effective students' mathematics engagement may result in positive relationships beyond pedagogical relationship to what happened in practice during classroom instruction (Attard, 2015).

In an engaged mathematics classroom, substantive conversation about mathematics concepts and content and their applications to everyday life are discussed (Attard, 2015; Bature & Atweh, 2019). During these discussions, complex, yet positive tasks are provided, opportunities for all students to achieve a level of success in these complex and challenging tasks are also provided, in the atmosphere of friendship and community of practice (Bature & Jibrin, 2015). During these sessions appropriate knowledge and understanding are shared and collaborative and group goals are achieved using students centred approaches to learning (Attard, 2015). The relevance of the learning concepts and content are linked to the student's real-life situations outside the classroom (Bature & Atweh, 2016). The benefits of this form of classroom engagement empowered students with the capacity to transform and reform their complex mathematics concepts into real-life related concepts Attard (2015), Bature & Jibrin (2015), Bature & Atweh (2016; 2019) and solution are sought in a community of engaged students.

Promoting substantive conversation during problem solving provide students with access to the components of engagement which Attard (2015) described as; reasoning, communicating, understanding, fluency and problem-solving. These provides mathematics teachers with opportunities to assess their students in the key components of students' engagement as described by Attard (2015) and the Board of study NSW (2012).

The provision of opportunities for all students to succeed in these tasks could sometimes be a challenge to developing teachers, however, with experience, the develop an understanding of the concept and strategies would be developed. This may eventually improve their ability to manage such classrooms. For example, Attard (2015) was of the view that it is often a challenge for teachers to differentiate activities to ensure the diversity of abilities among students. In such cases teachers and their students need experience to achieve success and develop a positive attitude towards mathematics problem solving.

One way of ensuring that all students are challenged during classroom engagement is to provide them with open-ended, rich task, then providing them with closed-ended problems that only have one correct answer or limited opportunities to apply the critical thinking skills and the use ofa range of strategies. Attard (2015) supported this by saying;

> "*Allowing student choice in the mathematics classroom is an important element of engagement and sends important messages relating to power and control. You can provide choice, by having alternative activities within a specific mathematical content area, or you can have students choose how they present their work. Perhaps students may choose to work with concrete materials or interact with appropriate technology. This does not have to occur in every lesson but allowing students the freedom to make choices every now and then can contribute to their overall engagement" (P2).*

There is an increase in the study of students' engagement in the area of mathematics education. It is often associated with concepts like participation, interaction, collaboration and student's involvement in classroom discourse in problems solving (Bature & Atweh, 2019; 2016). Sullivan et al, (2006) called it participation or effort. Researchers have also linked the concept of engagement to different aspect of problem-solving during mathematics classroom

instruction (Sulivan et al, 2006). Earlier researchers in mathematics education describe students; engagement in mathematics as the avoidance of negative feelings in mathematics called mathematics anxiety (Mcdonald, 2013; Bature and Bature 2006).

The term motivation for engagement according to Williams and Ivey (2001) suggests the degree to which students choose to actively engage in classroom activities, and the opportunities available tothem as it relates to mathematics. Effective researchers like Egeberg, McConney, & Price, (2016) and Mcdonald (2013) habitualised students' behaviour and patterns of students' engagement in their conceptualisation of their core mathematics concepts.Sullivan et al (2006) and Dweck (2006)'s research findings suggest that the extent to which students' efforts contribute to students' success in mathematics problem solving andstudentss enjoyment of their mathematics classroom instruction depends on the perception of their engagement in mathematics classroom activities. The finding of that study suggested that students chose not to engage in classroom activities because of the classroom culture created by the mathematics teachers and not because of their inability to be engaged (Sullivan et all, 2006).

From the study of Sullivan et al., (2006) and Op 't Eynde (2004) it seems that, classroom culture, engagement in local language, rules and practice that govern activities in the community of students may be more important in determining students effective engagement in mathematics, than the curriculum, method of teaching, mode of assessment, teachers experience and level of resources. This paper seeks to investigate the perception of students in their engagement in problem solving during mathematics classroom practice.

The Method

This section discusses the methodological approach to data collection. In this section the researchers will discuss the design of the study, the participants, the instruments and the instrumentation in data collection, the ethical issues, the validation of the instrument and the data collected, and the strategies the researchers adopted to analyse the data collected.

The Design

The study employed a qualitative case study approach to seek information from 6 students in two secondary schools in Northern Nigeria. The research methodology allowed the researchers to explore subjects of their study through complex interventions, studying relationships, and behaviour of subjects in details through systematics investigations (Yin, 2006). This is with the aim of promoting the deconstruction and the reconstruction of the issues under investigation or study. When the approach is applied correctly, it becomes a valuable tool for seeking data with the view of developing interventions and obtaining deep knowledge and understanding of the concept under investigation. Stake (2005) and Yin (2006) view qualitative case study in different perspective, however, they both seek to ensure that the concept under study is well explored and the essence of the concept under study is revealed.

The Participants

This research is aimed at studying students' perceptions and views about the use of engagement in their classrooms. Four mathematics teachers with a range of experiences in teaching mathematics ranging from 5 to 7 years volunteered to teach mathematics in two senior secondary school for a period of 15 weeks spanning across 2 years. While six students volunteered to participant in focus group interviews to discuss their perceptions on the new classrooms created by the mathematics teachers.

These students are Micah, Michael, and Mike (boys) and Janet, Julie, and Jane (girls).

Instrument and instrumentation

Classroom instructions and the focus group interviews were videotaped or recorded. While the researchers maintained a research journal to record observations, discussions, and intermittent interviews with the focus group students.

Workshops: Given that student engagement in problem solving was a new concept of classroom practice in Nigeria, there is the need for the mathematics teachers and the students to be acquainted with the concept and develop understanding on how to implement the concept during their classroom teaching. Therefore, before the research started, the researchers had to provide an intensive one-week workshop to educate the mathematics teachers and their student on how to use classroom engagement to encourage student's problem solving in mathematics. The researcher also provided support to the mathemetics teachers throughout the study with the view of assisting the teachers create classrooms that are engaging.

Observation: The researchers adopted the observational strategy to obtained data for the study. There were both in-class observation of teachers and students practice and the out-class observation through intermittent interviews with the students. The in-class observations were done to measure the level of student engagement in problem-solving during classroom instruction of the four mathematics teachers. The in-class observations were Video-recorded to capture students' engagement during classroom instruction. Key indicators, like students' participations, student's collaboration, involvement in problem solving with other members of the class, the ability to contribute to classrooms activities etc are some of the key indicators the researcher was looking for. All actions related to the research objectives were captured both in writing and in video recording.

***Focus Group Interviews*:** There were two-hour focus group interviews after every three weeks of the mathematics teacher's classroom practice. The researchers and the focus group students meet and discussed students' views and perceptions on the new classrooms created by their teachers during the research. During these periods, the researchers and the focus group students discussed extensively on their perception of the concept of engagement in mathematics problems solving. Since this study was part of a major study, the analysis concentrated on the focus group interviews with the students. This is because the researchers in this article concentrated on the perceptions and views of the students on the benefits of classroom engagement on students' problem-solving during mathematics classroom instructions.

Researchers Journal: The researchers also kept a research journals to record all other observations and interactions with the focus group students. Particularly those actions and reactions or behaviours that were not captured by the video.

***Reflective Interview*:** There were two-hour reflective interviews after every three weeks of the mathematics teacher's classroom practice. The researchers and the mathematics teachers had briefing sessions where participants and the researchers reviewed the classroom practice of each of the four mathematics teachers. During this period the researchers and the mathematics teachers as a team discussed the weaknesses and strengths of each teacher before launching into the next three weeks. There was a total of four reflective interviews with the mathematics teachers throughout the one and half years of research.

Validation of the Instruments and Data. Several techniques were adopted by the researchers to validate the instruments used in collecting data for this research. The first step of ensuring the validity of the data collected was

choosing a well-trained and skilled moderator or facilitator to look at the quality of the data collected. This was done by a senior academic in the faculty of education. The moderator checked personal biases and expectations of the research. While a good moderator is key, another strategy adopted to validate the data is the choice of the sample group. The participants were truly members of the segment from which they were recruited.

The researchers also employed ethical recruiting to collect data from mathematics education specialist who are truly representative of their segment, which the researchers believe will lead to achieving a valid result. The researchers also employed triangulation strategy to validate the data by adopting multiple perspectives of using several moderators, and different locations with the view of getting the results from different angles. The respondent validation strategies were also used deep saturation into the research with the view of promoting validity and finally, the researchers also sought an alternative explanation of ideas from the participants.

Ethical Issues: Appropriate ethical issues that involved taking permission from the school and the parents of the students used for this study were followed. For example, all the mathematics teachers used in the study voluntarily consented to participate in the teaching and engaged in reflective interview/meetings, casual discussions and some intermittent interviews were also used as means of providing support to the teachers. Prior to this, the researchers obtained relevant ethical permission from the school to conduct the research. Relevant consents were also obtained from the mathematics teachers' head of department.

Data Analysis: Data analysis in this paper concentrated on the views of the students on their perception on the role and effect of engagement in fostering effective problem-solving during mathematics classroom practice. The research adopted the narrative approach to analyse the data collected in the study. This agrees with the views of Clandinin and Connelly (2000) who were of the view that narrative could be used in analyzing research data that the researchers might have recorded through a journal or a diary, or that a research might have observed from individuals and or recording of fieldnotes during data collection. During narratives the researchers seeks to identify patterns; themes; categories; codes; and structures in analyzing qualitative data collected through a process of rigorous and constant comparisons of related themes (Creswell, 2005). In qualitative research, the researchers usually collect junk of data, however, the researchers break these data into themes, codes and sections Braun & Clarke (2006), Clarke (2006) with a view of making meaning with them.

Results

This section discusses the results of the data collected during the investigation using the two research questions postulated above. The researchers use the following themes to discuss the results of the data collectiod. First, the researchers discuss the initial perception of students on the concept of enagements in problem solving during mathematics classroom practice. Second, the researchers diuscusses the perceptions of students on the benefit of engagement in their problem-solving acticities during mathematics classroom instruction.

The Initial Perception of Students on Their Engagement in Mathematics Problem Solving

Research Objective 1:

To investigate the initial perception of students on their engagement in mathematics problem solving

Data collected suggested that the domineering and the unfriendly attitude of teachers during classroom instruction sometimes make students dislike mathematics. This suggest that students' problems in mathematics are not restricted to their negative attitude to mathematics but

could be because of the way mathematics teachers organised their classrooms. Julie argued;

> *Generally, in most mathematics classrooms, teachers are too strict and scare students away from participating in classroom activities…, To my own understanding mathematics teachers are not supposed to be strict because students are finding it hard today to learn mathematics. (Julie: Focus Group).*

> *You sometimes find it difficult to understand what the mathematics teacher is saying, and you dare not talk…, Some teachers can even send students out of the class if they ask questions or seek clarification from their friends (Janet; Focus Group interview).*

> *…, sometimes some teachers will even send you out of their class, if you asked questions, and I wonder how this idea of engagement will work? These teachers are encouraging students to talk or share ideas in the class…, it looks strange…., Sha… let us watch and see (Julie: Focus Group)*

Because of the unfriendly atmosphere created by most mathematics teachers during classroom instruction, data collected suggested that such atmosphere where unfriendly to the students. Such unfriendly atmosphere and attitude of the mathematics teachers makes students dislike mathematics. From the perception of Janet, some mathematics teachers are adamant and stick to the unfriendly and domineering traditional teacher centred approach to the extend they could go as far as sending their students out of the classroom, if they discover such students are trying to engage their colleagues in sharing ideas with one another to get more understanding. This suggest that students are finding it hard to learnt mathematics in most Nigerian classrooms because of the strict stand of mathematics teachers during classroom instruction.

Continuing with the nature of traditional mathematics classroom demonstrated and observed by the focus group students, there was the view that, when mathematics teachers are strict during classroom instruction, it sometimes causes mathematics phobia among students. This suggest that students are sometimes scared due to the unfavourable classroom climate created by their teachers, thereby affecting their engagement in problem solving.

> *Sometimes, the way the teacher approaches students makes us dislike mathematics and indeed the mathematics teacher…., some students sometimes feel humiliated and sometimes say the mathematics teacher is wicked..., and hence dislike his teaching no matter how good he is. (Micah: Focus Group)*

> *Sir, …, sometimes the mood on your face alone makes people to be attracted or run away from you, and if your mood is friendly the students will be willing to listen to you. But when your mood is not friendly and you tight your face, I personally will be scared of you and whatever you are saying, I will not pay attention to you, and I will not enjoy or understand what you are saying as a teacher in the class, because of your strictness as mathematics teacher. (Julie: Focus Group).*

> *See sir, sometimes the teachers will just be talking in the class not minding if the students are following on not…, and …, a student could have discovered that he or she is lost and not following what the teachers is saying…, I mean …, he/she could find it difficult to understand what the teachers are saying ..., and you cannot talk,*

because you could be humiliated or send out of the class… (Researcher's Journal)

The focus group students were of the view that, they were already used to the traditional mathematics classroom setting created by their teachers, shifting to a more student-centred classroom where engagement is encouraged looked an impossible task for them, since they were already used to depending on their teachers for all their learning needs. They argued;

…, I wonder how this idea of engagement will work. These teachers are encouraging students to talk or share ideas in the class…, it looks strange…., Sha… let us watch and see (Julie: Focus Group

Sir, how do we get involved in our learning? Teachers are meant to teach us, by solving examples for us in the class, and we copy and followed the formula and do the classwork…. But this idea of discussion, or sharing ideas with our classmates looks strange and difficult (Jane: Focus Group)

That is true Jane, how are we going to know the formula to use? (Janet: Focus Group)

I wonder….!! I though mathematics is all about formula?... (Mike, Focus Group)

That is true, you need teachers guidance, support and you also need your effort, the effort of your colleagues, when you put all these together you will discover that you can do it with your colleagues and even better… all you need is some confidence, some level of thinking and some level of practice…. You can do it better…, (Researcher: Focus group)

The Perception of Students on the Role of Engagement in Mathematics Problem Solving

Research Objective 2:

To investigate the perception of students on the role of engagement in mathematics problem solving.

From the perceptions of the student, they observed a gradual change in the teacher's classroom practice. This did not just happen as there was an ongoing scaffolding, reflective meetings and support from the researcher. The researchers extensively discussed the views of the students with the teachers about their classroom instruction. Similarly, from the data collected from the study, the perception of the students was that the mathematics teachers gradually developed strategies to improve their practice. When the mathematics teachers came back for the next three weeks of their teaching, they observed the mathematics teacher's gradual improvement in their pedagogy. This helped them increases student's engagement in problem solving. Data collected suggested that the students enjoyed their new classroom instructions. This was observed or identified through the following benefits

Students Perceptions on their Collaboration within the Classroom: Data collected suggested that the students discussed the benefit they obtained from collaboration as evidence of engagement within their classroom during the study. According to the students, there was collaboration of ideas among them, they shared ideas among themselves on strategies to find solution to their problems.

All the group members solve the problems together, you bring your own idea…, I bring my own idea… we join it together… and solve the problem. I think that is good. (Julie: Focus Group).

This is not only you alone thinking on how to solve a particular problem, the thinking was in groups,

by the time we join our heads together and think on a solution to a particular mathematics problem, you bring your idea… I bring my idea…, the solution becomes easier. (Julie: Focus Group).

That is true Julie…, when the teacher was teaching, he gave us a question to solve, and that question was "firebulous" (meaning too tough), we had to think…; think…; and think…; in our groups before we were able to come up with the clue of what to do. (Mike: Focus Group).

There was good classroom participation (engagement)… every member of the class participated…, the teacher always asked students to solve problems on the board instead of him doing (Solving) it for them, the students were doing most of the work and he (only) assisted when he discovered that the students are hooked-up…, I think thes approaches aid students' understanding better than whjen the teacher controlled all classroom activities (Jane: Focus Group).

When the students are hook-up…, I think these approaches aid students' understanding better than when the teacher is doing all the work. (Jane: Focus Group)

The students were of the view that thinking collaboratively was a better way of solving complex mathematics problems. Due to the effectiveness of the collaborative thinking and collaborative groups created by the mathematics teachers the students observed that they were not passive recipients of knowledge but were active creators of their knowledge in the atmosphere of collective bargain. From the perception of the students they were actively engaged in creating their knowledge. Similarly, from the argument above, it suggests that the framework created a sense of self-discipline among the students as against the usual student's distractive classroom environment experience during traditional classroom instruction. Their engagement in problem solving makes their learning collaborative, create an atmosphere for students to share ideas and become responsible for their learning.

Students Perception of their Engagement on Problem Solving: Data collected suggests that, the teaching strategy adopted by the teachers encourage student's engagement in problem solving.

Our mathematics teachers were good; they engaged us in productive problem solving…, they kept us busy..., we were so busy so much so that even those students that cause trouble in the class had no time for it… everyone was busy and on task… (Michael: Focus Group).

That is true Michael we were all involve (engage) we worked in groups…, my initial thoughts that the classroom will be noisy and distractive, especially those stubborn boys in our class…, (name withheld) …. Hmnnn…, Sir…, (debate with the boys) see sir, …., These boys…. these boys….??? But we were all busy… it was good…. (Julie: Focus group).

Hmnn Sir…., Julie is trying to pull our legs as if…. However, she is right everyone was busy… everyone was involved…. In fact, including the slow learners …, I think we need these in mathematics class…, (Micah: Focus Group).

That is true, …. The sitting posture created by the mathematics teachers tends to encourage slow learners. We were fixed to sit in groups like in a circular form, and we were made to solve problems together…, Share ideas together…, interact with one another in the class, that encouraged the slow

learners…, they were not left out…, they were carried along. It also made us so engaged; we debated and defended our solutions… and everybody was contributing his or her ideas in the class. (Jane: Focus Group).

I think these teachers were good …, after our first meeting, the came back really prepared…, the task giving to us was very challenging so were fully engaged in solving problems in the class. We were engaged in complex classroom task which really kept the students busy (engaged) and away from distraction…, Julie is right… the bully boys had no space…, to me they were busier than us…, (Micah: Focus Group)

This suggest that when mathematics teachers provide opportunities for students to collaboratively solve complex and challenging problems, students tend to be more engaged withproblems that requires mere recitations of facts. In view of this the research concludes that; highly intellectual quality mathematics problems keep students away from unnecessary distractions. Similarly, when complex problems are given to students, collaboration among students during problem solving is enforced and encouraged. It encourages the spirit of dialogues, debate and sharing of ideas during classroom instruction. For example, Michael said,

There was a problem given to us on quadratic equations which was difficult…., we were all confused on how to solve it…., but we shared ideas together with our classmates, we seek for other alternative ways of transforming the questions from indices to a normal quadratics equation, that was challenging… however after much deliberation with my team, we were able to find solution to the problem. (Michael, Focus Group).

That is true Michael, I never believe we can solve the problem, I was initially confused, are we treating quadratic equation or indices… (Jane: Focus Group).

The question given was truly somehow difficult to solve, and the teacher allow us to discuss and interact in groups…; everybody put his or her head together, after much argument, we were able to find the solution…, (Janet: Focus Group)

Were you able to find the solution Janet? (Researcher)

Yes sir…, the problem was eventually solved. (Janet: Focus Group)

Actually, we seem to be missing something here…, (Jane: Focus Group).

Hmnn…, Jane…, what do you think we are missing? (Mike, Focus Group).

The role of the teacher. Apart from the comments of the teacher that served as motivation to the us. The teachers were working around to provide support…, (Jane Focus Group).

That is true…, The teachers not only in this quadratic equation but in other problems (Julie; Focus Group).

We also make sure every member of the group was able to solve the problem. (Jane: Focus Group).

This suggest that complex or challenging problems are better solved through collaboration among students. Through this student will be able to share ideas with one another. When mathematics teachers encourage the

collaboration of thoughts and ideas during classroom instructions complex and challenging mathematics problems are easily solved. Similarly, mathematics teacher's role of providing support, and scaffolding during problem solving could help forester effective engagement among students particularly the disengaged ones. Finally, comments made by mathematics teachers during engagement could either fostered effective engagement or demotivate the students and make them disengaged in problem solving activities. Jane asserted,

> *…, when the teacher said …, anybody can be called to solve the problem or defend the solution for the group. It makes everybody sit up and make sure he/she understands. This is because we did not want to be called and disappoint members of our group and we did not know who will be called to solve the problem on behalf of the group. (Jane: Focus Group).*
>
> *That statement from the teachers, motivated every student to make sure he understands, and help every member of the group to also understand the problem. We talked, we shared, we argued…, we also do the work together…, and all had our problems solved together as a group… (Julie: Focus Group).*

From the view of Julie above one could conclude that effective engagement would not only help students solved their problems, but that the strategy provided them the confidence to dialogue, argued and defend their thoughts and views in an atmosphere of friendship and togetherness. The social justice principles of debating and defending their solutions made the classroom environment fascinating and enjoyable.

Students Perceptions of the Quality of Interaction during classroom engagement. Interactive classrooms are classrooms where students learn through their engagement in problem solving by gathering and processing information through their relationship with their peers and other resources around their classrooms. Data collected suggested that the interaction between students during the classroom instruction bring students together, add to mathematics classroom effectiveness and encourage students' self-generation of knowledge as promoted in constructivist epistemology.

> *The teachers brought us together and it was like there was good interaction between the teacher and the students and between students. (Mike: Focus Group).*
>
> *To me there was a good interaction between the teacher and his students…, the teacher did his or her best in maintaining these interactions in the class, which I believe leads to deep understanding among the students. (Jane: Focus Group).*
>
> *Yes sir, you can really see the student talking among themselves…. I wonder, it was not the normal distractive talk, but the talk was about mathematics, how to find solution to the problem…, (Micah, Focus Group).*
>
> *I initially thought that this discussion will lead to unnecessary distraction to the class…, but to my surprised…, it did not…, we were busy…, this is good (Janet: Focus Group).*

This suggest that effective interaction during classroom instruction encourage student's engagement in mathematics problems. It reduces the concept of side-talks, that are generally, frowned at by mathematics teachers and increases problem solving and conceptual understanding of students without the lost of computational mastery of the concept being learnt. The

findings also suggest that if properly managed, the general distractive classrooms experience during the traditional teacher-centred epistemology gave way to a complex classroom environment that fostered effective debate, negotiation of ideas, dialogues through the mathematics - talk that prevailed in the classroom. The general facilitation of skills that heightened student's attention, assimilation and retention of learning materials were promoted and demonstrated by the students through effective classroom engagement created by the mathematics teachers.

***Students Perceptions of their Relationship with the Teacher*:** The general perception of the unfriendly relationship between teachers and students during classroom practice still exist in most Nigerian mathematics classrooms. However, data collected in this research suggest a positive improvement in relationships between teachers and their students. From the perception of the focus group students creating classrooms engagement among students could forester effective relationship during classroom instruction, data collected suggested observable improvement in the teacher-students relationship.

> *… I think we need a free and fair classroom environment where everybody will have the opportunity to approach the teacher on areas, we are having challenges. The teachers created this environment for us…. They were friendly and approachable. (Janet: Focus Group).*
>
> *…, Yes Janet…, the appearance of our teachers was welcoming..., they tried their best to respect the class and the class also respected them. The teachers also appreciated and respected our opinions and the ideas we brought to them…, they appreciated them and were not (like) discarding them…, it made me feel proud and belonging (Jane: Focus Group)*

This suggests that, when mathematics teachers recognise and respect the views of their students during classroom instruction, the general bossy and unfriendly attitude exhibited during classroom instruction by Nigerian mathematics teachers would be reduced. Classrooms relationships that are cordial, friendly and in a relax atmosphere can increase student engagement in mathematics problem solving, and also provide opportunities for students to productively engaged in quality classroom learning. Julie said;

> *I think from what I saw from the teachers that taught us…this new classroom brings about good and cordial relationship between the students and their teacher; In fact, it brings about good relationship between students also (Julie: Focus Group).*
>
> *I wonder how this change was so natural and dramatic …, I hope my teachers will learnt from this and continue from where these researchers stopped. (Julie: Focus Group).*
>
> *…, It's like someone is always there… very close to you… to say, O girl? Is there any problem? Do it this way, this way, and this way. The classmates also… the teachers… are always there… willing to assist… willing to show the way..., I think this is the right way classroom should be…, everyone is relaxed…, (Jane: Focus Group).*
>
> *… the framework makes all students equal…, teachers are no harsher and harder on students… there was cordial relationship between teachers and students, and everybody was regarded and respected…, (Janet: Focus Group).*

> *…, I think in my view a good mathematics teacher is friendly and listened to student opinions, and that I observed from my teachers…, every student contributes to his classroom practice and had his/her opinion counts. (Janet: Focus Group).*

This relationship was not restricted to students and their teachers, the study also observed positive improvement in their own relationship. This suggested that, when mathematics teachers create good classroom relationship, positive relationships are also fostered between students, friendship and unity among students increases and hence, enhances quality engagement during classroom instruction. The researchers observed,

> *…, the classroom climate created by the mathematics teachers brought about good student relationships. …, they were united with one another …; there was no room for misunderstanding and misrepresentation…, there was cordiality among the students…. (Research Journal).*

> *The classroom environment created by the teachers brings about unity and love among us (students)…, there was this general and strange (though excellent) cooperation among us…, the classroom seems bonded together…. It was an experience (Janet: Focus Group).*

Students Perceptions on Support that Prevailed in their Classroom: From the data collected, the perception of the focus group students on support was more on the benefit of support and how it affects their personality during classroom instruction. According to the students the objective of showing support to the fellow students is to make both the giver and the receiver of the support happy. The result suggest that support brings about the sense of belonging among colleagues. When all student feels included during classroom instruction there will be a positive atmosphere of sharing ideas and knowledge among the community of learners. Julie asserted that,

> *..., support should be given to students whether in the class or outside the class…, it's still supports, making a member of his class happy should be the priority. (Julie: Focus Group).*

> *That is true Julie… do you know when the Biro of a member of my group stopped working… she got offers from so many students including those outside our groups…. (Janet: Focus Group).*

> *That is how a good class should be … looking at one another's back (Michael: Focus Group).*

The perception of Julie and her colleagues suggest that supported students feel secured and protected during classroom instruction. The perception of the students suggests that there is this feeling that someone is not willing to provide assistance when a student is in need; be it academics, social or academic. The reason for providing support was also discussed among the students. From their view the essence of support is not for showup but rather should be given with an open mind and not to embarrase the recipient. This suggest that our attitude to one another during support should not be that of allowing self-aggrandizement but should be that of showing benevolence to one another.

> *Just as it is said, "your right hand should not know what the left hand is doing…, right? I can give out my pen to my friend without you knowing. Our support should be self-less. (Micah: Focus Group).*

> *That is true…, Did you hear that Julie? (Mike: Focus Group).*

Tohhh…. What are you up to now Mike…? What do you mean…? (Julie: Focus Group).

Don't Start…, two of you…, we are talking of support and not fight…, Micah had hit the nail on the head… the right hand should not know what the left is doing…, Mike did you hear that? Live Julie alone (Janet: Focus Group)

Students Perception on the Resulting Inclusive Classroom: Data collected from the students suggested that students' inclusion was one of the efforts made by the mathematics teachers in creating classrooms that encourage engagement among students during problem solving. According to the perception of the students, they enjoyed the classroom and there was an atmosphere of love and inclusion. They had a sense of belonging in the community of learners where their needs and feelings were respected, and the climate was free from clamour and sentiments.

There were good relationships between students and the teachers in my class. This made the class lively and interesting…., every member of the class was carried along and every set of the class was identified and recognised. (Michael: Focus Group).

From the way the teachers were teaching…, I like it. The dormant group were fully recognised and carried along. Every student's opinion was respected…; the teachers were (like), making sure everybody is carried along and should be able to solve problems. This means they wanted everybody to be involved. (Julie: Focus Group).

The low achieving and non-participative students were made to be involved in the classroom instruction. That is, those students who don't really want to contribute anything during classroom instruction were made to contribute their ideas to the success of the class. (Jane: focus Group).

From the perception of the students above it suggest that when their feelings and views are regarded and respected during classroom instruction students tend to appreciate their classrooms and become more engaged. The comments of the students also suggested that slow learners, introverts and other disadvantaged students in the class are generally identified by the teachers and the classmates. Similarly, data collected in the study suggested that the mathematics teachers provided opportunity for cultural and religious inclusion. All the key element of religion and culture were identified and used for the benefit of students' engagement in mathematics classroom.

The mathematics teachers knew what they were doing…, they were able to make sure that everybody was included…, the grouping the teachers did was not based on tribe or religion …, the students were scattered to sit with other students…, not because he is my friend/not my friend. (Micah: Focus Group).

…, the mathematics teachers were able to identify the needs of the boys and the girls, low and high achievers, different cultures represented in the class and the different tribes. The mathematics teachers were able to do this because of the grouping system they adopted (Jane: Focus Group).

Yes, our teachers were able to identify the sets of people in the class…, they identified the sex or the gender of the students in the class…, the gifted and the slow learners…, those willing to learnt and those not willing to learn…, the teachers were able to make sure everyone feel belonged, comfortable

and at home. Generally, everyone in the class feels recognised and involved. (Micah: Focus Group).

Yes Micah, the teachers were friendly…, they carry everyone along…, they recognise the different set of students in the class, nobody feels inferior or superior, boys and girls were recognised and respected. (Julie: Focus Group).

The comments of the students above suggest that the mathematics teachers adopted appropriate strategies to assist disadvantaged groups during problem solving. These makes classroom teaching and learning more engaging and inclusive, classroom Barriers such as gender, religion, tribal and peer group sentiments are generally managed. Students work together for the growth of the community the belong to not minding their differences.

Discussions

This section will discuss the findings of the study using the following themes in line with the research objectives postulated. First, we shall discuss the traditional mathematics classroom practice as the initial perception of the focus group students. Secondly, we shall be discussing the perceptions of the students on the benefits of adopting classroom engagement during problem solving activities in mathematics classrooms.

The Traditional Mathematics Classroom Practice

Students' earlier perceptions of their classroom engagement in most Nigerian mathematics classrooms is that of passive involvement in classroom instruction. This was the perception of the students as they approached this research. Research findings in literature suggests that, in this type of classrooms, the teacher does the teaching and all the talking, while the students do the listening and only respond when they are asked (Bature & Jibrin, 2015; Brophy, 1999).

In this type of classrooms, the teacher dominates mathematics classroom talk and maintain basic structure that heavily rely on the teacher-centred classroom approach Brophy (1999), Emaikwu (2012); students' responsibility in this classroom is to listen carefully and copy examples given by the teacher (Emaikwu, 2012). This type of classroom does not encourage student's engagement, self-construction of knowledge and it only gives the teachers the opportunity to demonstrate their knowledge without minding the needs of the students. This does not make mathematics classroom instruction interesting and hence make students dislike mathematics and indeed, the mathematics teachers (Bature & Bature, 2005, 2006).

Another observation made by the students on the traditional teacher centred classrooms is the teachers' domineering attitude to classroom instructions. The students in the traditional classrooms see their mathematics teachers as possessing the monopoly of knowledge (Emaikwu, 2012). From the perception of the students, since their teachers know everything they need to know, there is no point engaging in some forms of discussion among themselves (Emaikwu, 2012). This suggest that the approach does not give opportunity to student to contribute to classroom discussions; it discouraged collaboration, engagements, interactions and effective knowledge constructions as proposed in the constructivist epistemology (Bature & Atweh, 2019; Ball, 2003;).

The focus group students also discussed the traditional classroom structure in terms of the teachers' unfriendly attitude to students during classroom instructions. This traditional approach permits the teacher to instruct the students traditionally; meaning the teacher controls all classroom's activities (Abanihe et al., 2010). Kaka (2007) disapproved of this method stating that the traditional teacher centred approach in Nigerian classrooms has

remained unquestioned. This is in stack contrast to the national objectives of mathematics as indicated in the national policy on Education (FME, 2006). However, as the research progressed, there were some evidence to suggest that the students did not only perceiveengagement as influential in changing their views about the pedagogy, but it also had a significant influence in their problem-solving activities.

Students Perceptions on their Engagement in Profitable Problem-Solving Activitie

The finding of the study demonstrated that the focus group students had opportunities for collaboration of ideas with their peers. This approach according to Bature and Jibrin (2015) and Bature and Atweh (2019) helped students share their experiences and their knowledge holistically, demonstrate collaboration of ideas and celebrate its authenticity with their colleagues. The strategy according to the perception of the students ensures that the members of the community (students and teachers) engaged in learning communities in which all participants have opportunities to engaged in productive discourse (Ball, 2013; Bature & Atweh, 2019).

The findings also ensure that students enjoyed thinking together, sharing their thoughts on how to come up with the solution of their problem. This suggest that, mathematics classroom instruction where students' ideas are solicited, shared and valued as important contributions to the developing of understanding of concepts and problems are valued is necessary for effective problem-solving activities (Bature, Jackson, Kemi, Shol and Sabo, 2015). This will give students the privilege to develop their own algorithms, construct their own knowledge and become responsible for their own learning as against the dominant authoritarian role played by most mathematics teachers in Nigeria (Bature et al, 2015).

There was the presence of collaborative thinking among students as a better way for solving difficult mathematics problems, as supported in a similar research conducted by Bature et al, (2015). This also help students' students engagement in classroom activities and provide opportunities for more student directed and actively participatory mathematics classroom problem solving as against the philosophy of mere passive recipients of knowledge asserted by Black and Solomon (2008), Ernest (2001), Kaka (2007), and Solomon (2007; 2008). Rather, they were engaged in creating and constructing their knowledge through collaboration of ideas, thereby creating opportunities for active engagement in mathematics problem solving (Bature & Atweh, 2019; Ball, 2003).

The Findings of the study suggest that the students were engaged in profitable problem-solving activities. This provides opportunity for them to assumed ownership of their learning (Bature & Atweh, 2016; 2019; Knowles, 1975), engaged in profitable problem-solving building their knowledge through collaborative thinking, and social interactions with the view of creating their own knowledge (Cavin, 2008). This also provide opportunities for students to learn and obtained deeper and richer understanding of mathematics through the problem-solving classroom climate created by the teachers.

Similarly, Bature et al (2015) was of the view that engaging students in profitable problems solving help them work in groups, take initiatives in identifying ways and strategies to finding solution to their problems, developed their own strategies and criticised and defend their views in a community of practice. This suggest that as students explained and justify their thinking and challenge the explanation of their peers, it helps them engaged in clarification of their own thinking and becomes owners of the knowledge they created (Bature & Atweh, 2016; Bature & Jibrin 2015; Lampert, 1990). This

perception of the students suggests that, profitable learning takes place through a process of sharing ideas, collaborating with members of the classroom and therefore helped students learnt relevant mathematics concepts and skills. These skills are developed or build through students' engagement in mathematics problem solving activities (Schoen & Charles, 2003; Solomon, 2008).

The findings of the study suggest that there was active participation of students in the classroom activities, they were not passive participants or recipients of knowledge as commonly practice in traditional mathematics classrooms (Abanihe et al., 2010; Black & Solomon, 2007; Kaka; 2007; Solomon, 2007). Similarly, the perception of the focus group students suggests that through their effective participation in problem solving they were actively engaged in creating and constructing their knowledge as proposed in the constructivist epistemology (Bature & Atweh, 2016; Bature et al, 2015). They control their learning with their teachers serving as supervisors, scaffolders and members of the classroom community (Bature & Jibrin, 2016).

Classroom engagement among students cannot be effective and efficient without profitable interaction between students. This was demonstrated and observed from the findings of the study. Classroom activities will end up being the usual teacher centred practice when learning is not made interactive among students. D'Ambrosio (2006) supported the views above by suggesting that, when students are engaged in profitable mathematics talks, they share ideas and knowledge with their colleagues, they initiate questions intended for their colleagues and their teachers which lead to profitable understanding among students.

The perceptions of the focus group students in this study suggest that effective and profitable students' engagement in problem solving can only be possible if mathematics teachers engaged their students in profitable interaction during classroom instruction. The initial fear of the researchers at the beginning of the study was that creating interactive classrooms could lead to students disruption of classroom activities, however when the study started it was discovered that students were profitably engaged by their teachers hence had no chance of engaging in any form of classroom distraction. From the perceptions of the students, their teachers were so smart and hence did not give them opportunity to engaged in any form disruption in classroom activities. This suggest that when teachers create classrooms that are engaging students become self-regulated and discipline among students is achieved (Bature & Bature, 2005).

In the traditional mathematics classroom in Nigeria, students tend to view their teachers as unfriendly and authoritative. The focus group students during the study saw a form of relationship between them and their teachers. In appreciation of the new relationship they saw they were of the view that the classroom climate created by their teachers were relaxed and friendly. This focus group student's perception suggested that, forestering positive relationship between students and between students and their teachers provide and effective tool for classroom engagement (Bature & Bundot, 2009 Bature & Atweh,2016; Bature, Atweh & Treagust 2016). Similarly, providing a positive and supportive classroom atmosphere during classroom instruction tend to forester student's engagement in problem solving, help students feel personally connected to their teachers, and colleagues.

The perception of the students also suggested that creating positive classroom climate enforced frequent communication among students, help students received guidance from their teachers and colleagues, and created the atmosphere of praised and not of criticisms from their teachers as against the traditional practice in most Nigerian mathematics classrooms. The perception of students in the study suggest that effective classroom

engagement tend to create an atmosphere of trustful, confident and freedom of expressions during classroom instruction (Bature & Atweh, 2016; Bature & Jibrin, 2015; Morganett, 1991). The findings of the study demonstrated that problem solving in mathematics classroom became more engaging and beneficial as a result of classroom relationships created. The student's engagement also created opportunity for students to develop new friendship as the classroom atmosphere created was beneficial.

Support from the perception of the focus group students is the ability to identify with someone in need. According to the students when a student did not understand a concept and another student provided assistance by explaining the concept to the students in doubts suggest classroom support. When students discuss mathematics with one another refining and critiquing one another ideas and understanding, help to reshape such ideas for better understanding of the slow learners and other members of the class signify support. This agrees with the view of Bature and Bundot (2009), Bature and Jibrin, (20150 and Bature and Atweh (2016, 2019), who were of the view that the amount of support the teacher provides to his students during classroom instructions must be commensurate to response to the needs of such students and that support during classroom instruction is not restricted to the one provided by the teacher, but should also be seen from the perspectives of the support students give to one another.

The perceptions of the focus group students in this study demonstrated the support students received from their teachers and from their peers, they were of the view that an atmosphere of support prevailed during the classroom engagement and they benefited from the support they received and or provided to one another.

The perception of the students in this study suggested that the support they provided or received from their colleagues and their teachers brought about the resulting inclusion that existed among the students. From the perception of the students this brought about fruitful; engagement in mathematics problem solving among students. The perception of the focus groups conducted with the students aligns with the findings of Bature, Atweh and Treagust (2016) and Gay (2000) that mathematics teachers response to the needs of their students during classroom instruction tends to make students have a sense of inclusions, honour and a sense of human dignity as against what applies in the Nigerian traditional classrooms where teachers sometimes say words that are demeaning to the personality of their students. This type of classroom promotes students' self-concepts, self-confidence, self-trust and improve academic and social outcomes as it fostered effective engagement in problem solving in mathematics (Bature et al, 2015; Bature, Atweh & Treagust 2016; Gay, 2000).

The perception of the students from the study also suggested that effective inclusion in classroom instruction makes students respect their teachers and makes them feel valued. In this type of classroom, students' views are respected and regarded. This suggest that mathematics teachers that provide inclusive and social support to the disconnected students during mathematics classroom instruction will forester and create an atmosphere of mutual respect and support between students and between students and their teachers (Atweh 2007, 2011, 2014, Bature, Atweh & Treagust 2016). The perception of the focus group conducted with students in the study also suggested that providing classrooms where inclusions and support is promoted, provides opportunity for students to support their colleagues especially among students with learning challenges.

Conclusions and Recommendations

This study was designed to investigate the perception of students on the role of classroom engagement in student's

problem solving in mathematics. Specifically, the study investigated perception of 6 students on the classroom instruction of 4 mathematics teachers in 2 secondary schools for a period of 2 years. Two research objectives were created or developed to guide the study. Research journal and video recording were used to document the focus group discussions and classroom observations. The findings of the study suggested that the mathematics teachers who made effort to engagement strategy as a tool to increase students problem solving abilities during mathematics classroom instruction achieved positive results.

The result of the study suggested positive increases in students' problem-solving skills. This was evident in the student's engagement in collaboration, participation, increase in positive relationships that existed between students and their teachers. The study also suggested that the mathematics teachers created positive classroom atmosphere for student's participation in classrooms problem solving, provided inclusive and supportive classroom for students' problem solving, and the general traditional teacher centred learning in mathematics classrooms that was the norm during mathematics lessons is gradually becoming de-emphasised. This was replaced by the increasing student-centred learning among the students. In view of these findings, the researchers propose the following recommendations.

- The implication for this study suggests that the practice of teaching mathematics in a more student-centred approach should be encouraged in Nigerian mathematics classroom.
- The study highlights urgent issues that teachers and teachers' educators need to act on to create a mathematics classroom that will make mathematics more engaging to students thereby increasing students' problem-solving abilities in mathematics. If this method is properly implemented, it will reduce the general traditional teacher dominated classroom practice of most mathematics teachers in Nigeria. The traditional teaching method will ultimately be replaced with a more relaxed mathematics classroom climate for students' effective engagement in mathematics problem solving.

- The study also suggest that the classroom instruction that view teaching as an individualistic approach, commonly practices in schools like Nigerian schools should be discouraged and a constructivist epistemology appproach, where classroom interaction, collaboration, dialogues, debates and other strategies that forester effective engagement in mathematics problem solving is practised should be encouraged. Research studies suggest that students in such classrooms generate their knowledge and are perceived and viewed active participants in problem solving engagement as promoted in the constructivist epistemology.

- The result of the study also suggest that it is important to encourage collaboration among students, with the view of providing opportunity for students to work with their colleagues to develope strategies for solving complex mathematics problems. This will also provide effective collaboration, opportunities to share ideas, think together on strategies to solve their problems, encourage rapport, foster students' confidence in problem solving activities, create opportunities for supportive and inclusive classrooms where students' voices are respected and regarded.

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