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Assessment of Teachers' Pedagogical Techniques in Addressing Students' Learning Difficulties in Mathematics

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Abstract:

The purpose of this study was to find out pedagogical techniques junior high school mathematics teachers use to identify and address the learning difficulties of their students. Descriptive design was used to survey 72 mathematics teachers in the Cape Coast Metropolis. Questionnaire was used to sample the views of the respondents whilst descriptive statistics were employed to analyse the resulting data. The outcome of the study revealed that mathematics students commit minor errors and careless mistakes; large class size also poses difficulties to students' learning. Strictly adhering to mathematics laws and principles was the major intervention measure mathematics teachers used to address their students' learning difficulties. It is recommended that mathematics teachers become extra careful and methodical in presenting facts in class. Teachers are entreated to spend quality time with students so as to diagnose their problems early enough to address them in time.

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1. Introduction

The test of time, teachers' influences are vital for any instructional programme to be successful and survive. Teachers serve as the agents to deliver the programme as required. However, their conduct in the classroom is a crucial factor of their professionalism which is broken further into the skills of teaching and knowledge in the specific subject area. These two components of professionalism serve as the potent forces that help in appraising a teacher's performance. Many studies have demonstrated that knowledge is a powerful force in learning and instruction, and it is also pervasive, individualistic and modifiable (Alexander, 1996). The debate over the kinds of knowledge teachers should have in order to be effective in the classroom looms large. This is due to the fact that most observers agree that successful teachers draw on specialized knowledge in their instructional work with students, but specifying and measuring this knowledge has proven elusive and controversial in education.

A teacher who is highly knowledgeable in a subject area still needs the skills of teaching that particular subject. Such skills are technically referred to as pedagogy. Pedagogy involves classroom management, motivation, communication, and students' involvement in lessons. Teachers' ability to impart knowledge to students depends mostly on the pedagogical strategies that are employed during teaching and learning. For instance, the teaching methods that teachers use have a significant impact on students' ability to grasp the subject matter. Most people would agree that an understanding of the content is paramount for teaching. Yet, what constitutes understanding of the content is only loosely defined. In the mid-1980s, a major breakthrough initiated a new wave of interest in the conceptualization of teacher content knowledge. Shulman (1986) and his colleagues proposed a special domain of teacher knowledge that they termed Pedagogical Content Knowledge (PCK). What provoked broad interest was the suggestion that there is content knowledge unique to teaching (a kind of subject-matter-specific professional knowledge). The continuing appeal of the notion of pedagogical content knowledge is that it bridges content knowledge and the practice of teaching. Thus, a teacher who is a subject specialist but lacks pedagogical skills is as deficient as a teacher who has pedagogical skills but is

not knowledgeable in the content area. This underscores the need for teachers to have knowledge in both content and pedagogy to become professionally useful as teachers.

An important aspect of a teacher's PCK is his/her ability to identify students' learning difficulty. This is particularly important in a mechanical subject like mathematics where rules, policies, concepts, principles, formats and procedures are emphasized. It is, therefore, important for the mathematics teacher to be able to determine whether students are following a specific instruction given in class. A teacher's role does not consist of teaching subject matter only (Golemark, 1994). It also involves the ability to detect difficulties that students have in the learning of the subject. These difficulties could be associated with the classroom environment; teaching methods used by the teacher; preconceptions and misconceptions students have about the subject, and the laws and principles that are inherent in the subject, among others. It is when such problems are known that teachers can provide remediation to rectify them to enable students improve their performance.

According to Strong, Thomas, Perini and Silver (2004), teachers need to have adequate content and pedagogical knowledge to enable them design instructional activities that take into consideration the learning style, ability and interest of pupils. It is what teachers know and how they know it that is important rather than how teachers think and make decisions (Shulman, 1986). That is to say teachers' knowledge and understanding of their subjects take precedence over instructional decision alternatives they formulate and implement. The particular ways teachers attempt to transform their knowledge into representations that make sense to their students are subsidiary to content and pedagogy. Shulman, 1987 asserts that, to teach all students according to modern's standards, teachers need to deeply and flexibly understand the subject matter to enable them create cognitive maps, relate one idea to another and address misconceptions. Teachers' ability to teach this way would depend on their knowledge of the learning difficulties of their students, and appropriate measures for addressing those difficulties (Golemark, 1994).

1.1 Statement of the Problem

Mathematics is among the important subjects on the school curriculum of most countries. The subject is seen by society as the foundation of scientific and technological knowledge that is vital in socio-economic development of the nation (Moris & Maisto, 2001). In Ghana, mathematics is compulsory for all students from primary to senior high school. On completion of one's basic education specifically, JHS, one is expected to get a pass in mathematics at least grade six before he can gain admission into any of our second cycle institutions. Many students in the Cape Coast Metropolis are unable to further their education after the junior high school because they failed in mathematics (Metropolitan Education Directorate (MED), 2016). According to the Basic Education Certificate Examination (BECE) report in Table 1, students' performance in mathematics was extremely poor as compared to the other core subjects. (MED, 2016). This rise and fall of BECE results in the Cape Coast metropolis may be due to some factors such as teacher's absenteeism due to high frequency maternity leaves, lack of adequate or poor preparation of pupils prior to examinations and teachers lacking the requisite skills and pedagogical content knowledge in teaching the subject (MED, 2016).

Aside these biological, sociological and economical causes, learning difficulties that arise from Curriculum Knowledge and Content Knowledge are of major concern to the researchers. Penso (2002) categorizes PCK into two main components: knowledge of the main aspects of the discipline in the teaching context and knowledge about learners and the learning processes. This study was limited to an aspect of the latter knowledge component, that is, how teachers identify students' learning difficulties and the strategies they use to address those difficulties. Also, the study did not concentrate on the biological, sociological and economic causes of learning difficulties of students. Rather, the study was concerned with the content specific and curriculum-oriented learning difficulties inherent in the teaching and learning of mathematics in the Junior High Schools (JHS) in Ghana specifically, Cape Coast Metropolis in Central Region.

Table 1: BECE Performance and Trend in Four Core Subjects and Metro Performance in Percentages (%)

Year	No. of Candidates	English Lang.	Mathematics	Int. Science	Social Studies	% Pass Rate (Aggr. 6 – 30)
2010	2817	60.3	36.7	47.9	52.4	57.3
2011	2790	62.5	36.1	48.2	47.5	50.2
2012	2872	62.2	40.0	41.0	49.0	48.0
2013	3123	55.9	39.1	42.8	42.8	42.3
2014	3061	76.36	51.0	50.5	62.9	47.6
2015	3195	76.1	60.1	70.5	62.6	49.2
2016	3148	77.5	58.0	69.1	61.5	51.6

Source: MED, 2016.

1.2 Objectives of the Study

The purpose of this study is to find out what pedagogical techniques junior high school mathematics teachers use to identify and address the learning difficulties of their students. Specifically, the study sought to find out:

i. the major learning difficulties junior high school students' have in mathematics,
ii. the sources of students' learning difficulties in mathematics,
iii. measures mathematics teachers employ to address students' learning difficulties.

2. Review of Related Literature

This section reviews literature related to the study. The review begins with theoretical framework for the study and discusses the concept of learning difficulties, causes of learning difficulties and strategies for addressing them. Secondly, empirical on various aspects of teachers' pedagogical content knowledge is reviewed.

2.1 Theoretical Framework: Pedagogical Content Knowledge

Current policies in Ghana for the teaching profession demand that practitioners have a high level of proficiency regarding the several areas that integrate the teaching-learning processes. Teachers in Ghana need to meet the challenges of helping themselves and their students to grow linguistically, socially, emotionally and intellectually (Hudelson, 2001). This requires that teachers dwell upon a vast range of knowledge in their work.

The term "teacher knowledge" or "teacher knowledge base" has long been a subject of intense research, and various definitions and explanations have been offered. The term was primarily regarded as the basic skills required for teaching. It referred to subject matter knowledge and the implementation of pedagogical strategies (Pineda, 2002). Thus, teacher education programmes sought to provide teachers with discrete amounts of knowledge, "usually in the form of general theories and methods that were assumed to be applicable to any teaching context" (Freeman & Johnson, 1998, p.367).

Shulman (1987) developed a knowledge base model for teaching made up of the following seven categories: content knowledge, general pedagogical knowledge, curriculum knowledge, knowledge of the learner, knowledge of educational goals and their philosophical bases, knowledge of educational contexts and pedagogical content knowledge.

The first category, content knowledge, has to do with being knowledgeable about the subject matter. In the context of teaching, content knowledge is what teachers teach. The second, general pedagogical knowledge is explained as the general set of methodologies and strategies that the teacher needs in order to carry out the teaching activity. The third category, curriculum knowledge, is described as the teachers' acquaintance of the curricular programme of the school and how they make use of it to favour their students' teaching/learning processes. The fourth, knowledge of the learner, refers to the teachers' engagement with the students' learning processes, considering their physical, psychological and cognitive characteristics. The fifth component of Shulman's model refers to knowledge of educational goals and their philosophical bases. This component

implies that teachers inquire about the educational system principles and the social expectations they are required to sort out as educators. The sixth category, knowledge of educational contexts, includes the characteristics of schools, classroom, communities and culture. The last aspect, pedagogical content knowledge refers to the broad principles and strategies of classroom management and organization.

The present study takes Pedagogical Content Knowledge (PCK) as its theoretical framework. Shulman (1987) defined PCK as "the most useful form of content representation, the most powerful analogies, illustration, examples, explanations and demonstration – in a word, the ways of representing and formulating the subject to make it comprehensible to others" (p. 9). Shulman went on to state that PCK includes a teacher's understanding of what makes the learning of specific topics easy or difficult; the conceptions and preconceptions that students of different ages and background bring with them to the learning of those most frequently taught topics and lessons. In this definition, it can be revealed that there is a blending of content and pedagogy into an understanding of how particular topics, problems or issues are organized, represented and adapted to the diverse interests and abilities of learners and presented for instruction. This brings to the fore the importance of content, pedagogy and students and the connections among them. Shulman (1986) emphasized that knowledge of multiple ways of representing content relies on the teacher's understanding of the content, and has as its purpose the transformation of that content into a form that students will understand.

PCK is a construct that consists of what teachers know, what they do and the reasons for which teachers do things. It can be noticed that PCK exists at the intersection of content and pedagogy. Thus it does not refer to a simple consideration of content and pedagogy in isolation; but rather to an amalgam of content and pedagogy, thus, enabling transformation of content into pedagogically powerful forms. Shulman argued that having knowledge of subject matter and general pedagogical strategies, though necessary, were not sufficient for capturing the knowledge of good teachers. To characterize the complex ways in which teachers think about how particular content should be taught, he argued

for pedagogical content knowledge as the content knowledge that deals with the teaching process, including "the ways of representing and formulating the subject that make it comprehensible to others" (Shulman, 1987). If teachers were to be successful they would have to confront both issues (of content and pedagogy) simultaneously, by embodying "the aspects of content most germane to its teachability" (Shulman, 1986, p. 9). At the heart of PCK is the manner in which subject matter is transformed for teaching. This occurs when the teacher interprets the subject matter, finding different ways to represent it and make it accessible to learners.

Since Shulman's publication, the concept of pedagogical content knowledge has been extensively investigated. This has led to expansion of its meaning and, therefore, multiple definitions. Geddis (1993), for example, viewed pedagogical content knowledge as a set of special attributes that help someone transfer the knowledge of content to others. Kathryn (1997) also describes PCK as a type of knowledge that is unique to teachers and is based on the manner in which teachers relate their pedagogical knowledge (what they know about teaching) to their subject matter (what they know about what they teach). She went on further to explain that it is the integration or the synthesis of teachers‟ pedagogical knowledge and the subject matter knowledge that comprises PCK. College of Education and Human Services (2006) also describe PCK as the ability to contextualize classroom practice or clinical practice based upon knowledge of how people learn or change in a particular content area and how that learning or change can best be facilitated. They indicate that professional educators, leaders, counselors and candidates should be able to demonstrate PCK by anticipating and recognizing common misconceptions, typical misunderstandings and developmentally appropriate response to instruction and assessment for the content area.

Since its introduction in 1987, PCK has become a widely useful and used notion. For instance, in the area of science education, scholars such as Anderson and Mitchner (1994); Cochran, DeRuiter, and King (1993); and professional organizations such as the National Science Teachers Association (NSTA, 1999) have all emphasized the value of PCK for teacher preparation and teacher professional development. The increased emphasis on

PCK is based on Shulman's acknowledgement that "pedagogical content knowledge is of special interest because it identifies the distinctive bodies of knowledge for teaching" (p, 9). Moreover, the emphasis on PCK is consistent with the work of many other scholars and recent educational reform documents. The components of PCK as identified by Magnusson, Krajcik and Borko (1999) are orientation towards teaching, knowledge of curriculum, knowledge of assessment, knowledge of instructional strategies, knowledge of context and knowledge of students‟ understanding. .

2.2 Learning Difficulties

Even though many scholars have defined the term "learning difficulties", there is no clear and widely accepted definition of the term. Indeed, there is an ongoing debate on the issue of definition. There are currently at least twelve definitions that appear in the professional literature but these disparate definitions do agree on certain factors (Child Development Institute, 2008).

In one sense, the term "learning difficulties" is used as a comprehensive term to refer to a range of problems that arise when information from the senses is not accurately received by the brain (Focus on the Family, 2006). The Australian National University (ANU, 1994) also adds that "learning difficulties" is a much broader term which refers to problems in developmental and academic skills which may arise from one or more of the following factors: intellectual disability, physical disability, inappropriate learning environment or emotional difficulties. A related but essentially different term is "learning disability".

The National Joint Committee on Learning Disabilities (NJCLD, 2005) defines the term learning disability as: heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to Central Nervous System Dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions (e.g. sensory impairment, mental retardation, social and emotional disturbance) or environmental influences (e.g. cultural differences, insufficient/inappropriate instruction, psychogenic factors) it is not the direct

result of those conditions or influences. The Australian National University (1994) explains that the key difference between "learning difficulties" and "learning disabilities" is that the latter is presumed to arise from neurological rather than intellectual, physical or sensory impairment. A learning disability or difficulty is not, however, an indication of low intelligence. Indeed, research indicates that some people with learning disabilities may have average or above-average intelligence (Hammill, 1990). Child Development Institute (2008) suggests that any definition of the term "learning difficulties" should have one or two of the following factors:

i. People with learning difficulties have difficulty with academic achievement and progress. Discrepancies exist between a person's potential for learning and what he actually learns.
ii. Learning difficulties show an uneven pattern of development (language development, physical development, academic development and or perceptual development).
iii. Learning difficulties are not due to environmental disadvantage.
iv. Learning difficulties are not due to mental retardation or emotional disturbance.

These factors buttress what Hannaford cited in Oliver (2008) stated that learning is not all in the head. It is full activation and balance of all parts of our mind and body system that allows us to become effective and productive thinkers. Therefore, if a student finds it difficult in articulating and balancing all parts of the mind and the body system in learning, then the person is described to have a learning difficulty.

2.3 Sources of Students' Learning Difficulties

Most studies indicate that there are many types of learning difficulties. Learning difficulties can be categorized either by the type of information processing that is affected or by the specific difficulties caused by a processing deficit. There are four stages of information processing; namely, input, integration, storage and output (National Dissemination Centre for Children with Disabilities, NDCCD, 2004).

During the input stage in information processing for learning, information is perceived through the senses, such as visual and auditory perception. Difficulties with visual perception can cause problems with recognizing the shape, position and size of items seen. Notwithstanding these difficulties, there could be problems with sequencing, which can relate to deficits with processing time intervals or temporal perception. Difficulties with auditory perception can make it difficult to screen out competing sounds in order to focus on one of them, such as the sound of the teacher's voice. Students who are not able to identify the teachers‟ voice from noisy environment may cause them not to be attentive hence not getting whatever is taught in the classroom which may also cause low performance for these students. Some students who have input difficulties in learning may appear to be unable to process tactile input. For example, they may seem insensitive to pain or dislike being touched.

The integration stage is the stage during which perceived input is interpreted, categorized, placed in a sequence, or related to previous learning (NDCCD, 2004). Students with problems in integration may be unable to tell a story in the correct sequence. They may be unable to memorize sequences of information. This may be exhibited when, for instance, mathematics students with this problem are being asked to add or subtract numbers. Because the activity requires the students to follow some sequence of steps, it may affect the presentation of accurate answers since students with this problem do not know the sequence they should follow. Again, such students may be able to understand a new concept but be unable to generalize it to other areas of learning.

Learning difficulties occur at the storage stage of information processing when there is a problem with memory- that either the short-term (working memory) or the long-term memory. In the case of mathematics students in the Junior High Schools, this research focuses mostly on the learning difficulties that occur as far as the short-term memory is concerned. By this aspect, mathematics becomes difficult to learn when new materials are learnt without many more repetitions than is usual. It is pertinent to be repeating what students have been taught for them to be able to remember. Students who have difficulties in storing of information in the short-term memory are at risk. This is because

the teacher may not spend much time or give more exercises to the students for them to become conversant with what the students have been taught. Students exhibiting this type of difficulty may have a problem, and to overcome this problem, the teachers need to repeat what they are teaching and give more practical exercises to the students for them to become conversant with what has been taught.

The last stage as far as processing of information is concerned is output. Information comes out of the brain either through words, that is, language output, or through muscle activity, such as gesturing, writing or drawing. Difficulties with language output can create problems with spoken language (NDCCD, 2004). For example, answering a question on simultaneous equation would require a student to retrieve information from storage, organize his /her thoughts, and put the thoughts together before he/she writes. A student who has a problem in this area may not be able to produce the answer correctly. It can also cause trouble with written language for the same reasons. For instance, if a student is given a final account to comment on the financial status of the company (report writing) the student may face some difficulties in putting his/ her thoughts together.

Difficulties with motor abilities can cause problems with gross and fine motor skills. People with gross motor difficulties may be clumsy, that is, they may be prone to stumbling, falling, or bumping into things. Mathematics students with this type of problem may not be able to present their work well and teachers may have difficulties when it comes to reading and marking their scripts; because of awkward hand writing. They may fail not because they were not able to get the answers right but the way they presented their work made them perform badly.

Chinn (2002) conducted a study on difficulties students face in learning mathematics. The study involved 160 pupils selected from Ireland, Netherlands and England. Chinn (2002) identified inappropriate teaching methods; problems in students' short term and long-term memory; language problem; speed of working and sequencing as possible causes of students' learning difficulty. He indicated that the learning of math is very dependent on the teaching methods being appropriate to the individual. He explains that we do not learn

in the same way and as math is a very sequential subject, in the sense that each new idea builds on previous learning, failure can be cumulative which may be a problem for the student in the future. However, if teachers are able to use the right teaching methods during teaching, students may not face such problems. This is because according to Sprenger (2003), the use of different teaching method by teachers will help them identify students learning difficulty. They also explained that by the use of the right teaching methods teachers can accommodate different learning style of students. Also, students who have short term memory are identified by their teachers to be students who lose tracks in the middle of doing a multistep mental arithmetic problem and they have problem in absorbing a sequence of instructions. Likewise, students who may exhibit long term memory difficulties are perceived by their teachers to be students who cannot remember sequence of steps needed to complete a given task such as long division.

On the aspect of language difficulty, every subject or course has its own language or vocabulary but if students are not familiar with these languages it may pose a challenge to them and hence be a learning difficulty. In home economics for instance, the word "take away" is a food that has been packed but in mathematics and accounting for instance, it means subtract something from a given figure. Speed of working is also a possible cause of students' learning difficulties. Chinn (2002) mentioned that, in math the requirement that one must do it quickly tends to increase anxiety and thus decrease accuracy. Math also requires sequencing ability. If students have the problem for sequencing, then it will be a problem to them. For instance, if they are to solve a long division or a BODMAS question, they may have problems because they may not know which one to start first, whether to start with the addition, subtraction, multiplication or division. The difficulty can however be linked with language problems in the questions.

In conclusion, if the teaching methods are appropriate, then the students' memory will also be enhanced. This is because good teaching methods will help students to get the understanding of the content very well. If students understand what they are doing, then there is the likelihood that their speed of working and the sequence which they have to

follow in solving a particular question will be made easier. The adverse of this poses a problem, hence a cause of their learning difficulty.

2.4 Intervention Measures for Students with Learning Difficulties

Intervention, according to Encarta Dictionary (2009), means an act of intervening, especially a deliberate entry into a situation or dispute in order to influence events or prevent undesirable consequence. An intervention may also be seen as a deliberate process by which change is introduced into peoples' thoughts, feelings and behaviours (Hazelden Foundation, 2009). The main objective of an intervention is to confront a person in a non-threatening way and allow them to see their self-destructive behaviour and how it affects themselves, family and friends. However, an intervention as used in this research refers to measures that are being put in place to address learning difficulties of students in the learning of mathematics.

Students with learning difficulties can be a challenge for any classroom teacher. However, the teacher applying the pedagogy that he/she has learnt in the course of his/her training is believed to be able to help such students. The intervention measures that the teacher will put in place will be dependent on the learning difficulty that the student will exhibit. For instance, students whose attention seem to wander or who never seem to be with the rest of the class might be helped by the teacher walking around the classroom as the lesson is progressing and tapping the place in the student's book that is currently being discussed. Also the teacher can give a signal that someone is going to answer a question that has been asked. The teacher can also use the students' name in a question or in the material being covered.

In addressing the needs of students with a learning difficulty, the emphasis is on good rather than necessarily extra teaching approaches because most students with learning difficulties can perform successfully after minor adjustments or modifications to teaching and assessment methods (ANU Students' Service, 1994). That is, teachers can enhance students' learning through a modified and or different teaching methods and the use of adaptive technology and educational materials to address those particular needs of

students. Again, the teachers can also provide alternative assessment and examination procedure which will still incorporate students' requirements in the teaching and learning of that particular subject. In the course of teaching, teachers may use demonstrations and concrete examples where appropriate and relate new or abstract concepts to everyday life. That is, teachers can frame materials by relating it to past classroom or personal experiences and highlighting new materials in the process of teaching and learning. In the area of mathematics, as an example teachers can call students to come to the board and provide solutions pertaining to questions so as to enhance their understanding of the topic being treated. Teachers can also give practical examples and encourage field trips to help in the teaching and learning of the subject.

ANU Students' Service (1994) suggests that the teacher should also explain complex ideas as clearly and as simple as possible. Repeating and rephrasing explanations and information will be the best option. Teachers should note that even though it is important to make room for students to ask for repetition, they should bear in mind that it is important to use the same language when repeating so that they do not change the construct and defeat the purpose of repetition.

Several studies on intervention measures to remedy students' learning difficulties have been compiled by Zhang and Xin (2008). The studies they reviewed were on algebra word problem instruction for students' with learning difficulties. The purpose of their review was to summarize the findings of published intervention studies for students' with disabilities or with low performance in algebra and provide suggestions for classroom practice. The studies compiled were based on experimental research which involved control groups and experimental groups, pre-tests and post-tests.

The study reported the use of representational intervention strategies which include pictorial, verbal or physicals aids and cognitive strategies intervention. Such cognitive strategies intervention was made up of mnemonic strategies, graduated instructional sequence, problem solving strategy, and self- instruction to help students who have difficulties to learn and recall information. The study also reported effectiveness of

cognitive strategies on improving students' algebra word problem solving. It was also identified that even though the curriculum that the teacher will be using will be good for learning, Class Wide Peer Tutoring (CWPT) was better to address students' independent learning. This means, teachers will go an extra mile to help students who may have difficulty in the subject that they are learning. On the aspect of students' assessment, the study indicated Assessment Results Immediate Efficacy (ARIE) to be a strategy that could help solve students' learning difficulties. That is when students are given prompt assessment results, they will be able to know where they fall short and the necessary measures to be taken to remedy the situation.

Zhang and Xin (2008) concluded that all intervention strategies that these researchers put in place in one way or the other improve students' performance across pre-test and post-test. But they also recommended that intervention effects with diverse students' population need to be addressed, especially in pre-algebra word problem instruction. Secondly, those effective strategies (CWPT, Assessment Result Immediate Efficacy, etc.) in single subject design research should be examined in large sample experiments, to test the effectiveness of those strategies in a diverse population.

Hristovitch and Mitchltree (2004) also conducted a study on middle school teachers' pedagogical content knowledge of fraction and decimals in rural middle school in the Northeast of America. The study focused on three sixth-grade teachers in the process of teaching the notion of fraction and decimals. Regular classroom observations were made and weekly meetings were held with the teachers discussing teaching strategies, students' learning and curriculum issues. The study indicated that the teachers failed to develop the operational conception; that is, in relating the theoretical aspect of the subjects that they teach with practical terms (learning theories), they also have difficulty in connecting new ideas with what they already know, employing hands-on activities and sequencing of topics. Hristovitch and Mitchltree (2004) therefore suggested that activities of the professional development programmes addressing teachers' pedagogical content knowledge should focus on enhancing teachers' ability to connect the idea of the particular subject that they are teaching, specifically on their skills, to work with prior

notions that are conceptually connected with them. Also, teachers need further institution and opportunities for exploration on how to use effectively hands-on activities and manipulative skills in a classroom instruction. More specifically, teachers need help in making transition from using hands–on activities and manipulative skills in the classroom just as means for illustration of directly introduced mathematical concepts. These would serve as tools (hands–on activities and manipulation of classroom instruction) for exploration and discovery leading to students' deep conceptual understanding of mathematics.

Jordan et al. (2005), discovered the following intervention measures to reduce students' learning difficulty in mathematics:

i. Magnitude comparison (i.e., knowing which digit in a pair is larger). With this intervention, students will be able to know which figure is larger and smaller and at the same time know which they are to deduct from and those that they are to add in addition and subtraction.

ii. Sophistication of counting strategies. With this, teachers should help students to know how they are to go about the treatment of each item in any question which pose a challenge to students. Jordan et al. (2005) found that a significant area of difference between students with number combination mastery and those without was the sophistication of their counting strategies. The poor combination mastery group continued to use their fingers to count on untimed problems between second and third grades, whereas their peers increasingly used verbal counting without fingers, which led much more easily to the types of mental manipulations that constitute mathematical proficiency

iii. Fluent identification of numbers was also identified as a possible intervention measure. Students with learning difficulty should be taught in such a way that they can store the necessary concepts and principles in a manner that they could retrieve facts quickly, effortlessly and without error. Mathematics students for instance, may be taught to be fluent in identifying figures when it comes to addition and subtraction. When students are taught the way numbers are identified fluently, when a question is given, they will not be found wanting.

3. Materials and Methods

3.1 Research Design

Selecting a research design depends on the reason for the study (Cohen, Manion & Morrison, 2004). Descriptive survey design was used in this study because of its relevance in the field of education. Rubin (2005), defines descriptive research as a process of collecting data in order to test hypothesis or to answer questions concerning the current status of the subject in the study. According to Gay (1992), the descriptive survey is an attempt to collect data from members of the population in order to determine the current status of that population with respect to one or more variables. Descriptive research studies are designed to obtain information concerning the current status of phenomena (Streubert & Carpenter, 2010). The descriptive survey design was considered the most appropriate for assessing and analyzing the PCK of mathematics teachers, specifically their ability to identify students' learning difficulties and the strategies that they employ to remedy those difficulties. The design provided the platform to reach the respondents and sought their views on the topic.

3.2 Population

The researchers were, however, interested in only public junior high schools in the region. The justification for focusing only on public Junior High Schools was that it is believed most public school teachers are professional teachers compared to those in private institutions. Even though these nonprofessional teachers may have the content knowledge, it is assumed they lack adequate pedagogy in teaching the subject. The target population of the study, therefore, will consist of all selected public JHS mathematics teachers in the Central Region. The accessible population will consist of JHS mathematics teachers in Cape Coast metropolis.

3.3 Sample

There were a total 75 public JHS in Cape Coast Metropolis at the time of the study with a total of 89 mathematics teachers. All the mathematics teachers in the 75 JHS were

targeted as primary respondents of the study. Thus, census survey was employed in collecting the data. The census survey was used because the researchers involved all the mathematics teachers in the schools. The research instrument was administered to all the 89 teachers, however, a total of 72 responded to the questionnaire representing 80.9% return rate. Out of this number, 44 representing 61.1% were males while 28 representing 38.9% were females.

3.4 Data Collection Instruments

Data for the study were collected using both close and open-ended questionnaires. The questionnaire was in two (2) sections. Section A consisted of 5 items and made up of the biographical data of the respondents. Section B contained 29 statements that will be responded to using a 4-point Likert scale labeled: strongly disagree (a value of 1), disagree (a value of 2), agree (a value of 3) and strongly agree (a value of 4). The section was structured into sub-sections to reflect the research questions. Items 6-16 on the questionnaire asked teachers on the major learning difficulties of mathematics students, items 17-23 elicited information about sources of students' learning difficulties in mathematics whereas items 29-37 sought information on measures teachers employ to address the learning difficulties of their students. It has been noted that closed and open-ended questionnaires are useful to elicit both quantitative and qualitative data (Best & Kahn, 2005; Fraenkel & Wallen, 2000). Also, many people's opinions can be elicited through questionnaires and participants can respond in a place and time convenient to them (Gray, 2009).

3.5 Data Analysis

The data collected were coded to reflect their corresponding categories in accordance with the following scoring key: strongly disagree-1, disagree-2, agree-3 and strongly agree-4. Afterward, the data were analysed using descriptive statistical methods – including percentages, means, standard deviations and graphs where appropriate. The statistical tools used for the analysis provided an opportunity to report the dominant variables and how respondents varied in their assessment of those issues.

4. Results and Discussion

4.1 Students' Major Learning Difficulties

Research objective/question 1 sought to find out the major learning difficulties of mathematics students. To answer this question, items 6-16 on the questionnaire asked teachers on the major learning difficulties mathematics students, with question 16 being an open-ended question. Their responses are presented in Table 4 and Figure1

Table 4: Major Learning Difficulties (N = 72)

Learning Difficulties	Mean	Std. deviation
Apparent inattention during lesson	2.18	0.76
Concentration difficulties	2.40	0.74
Difficulty in mathematical calculations	2.50	0.81
Minor errors and careless mistakes in solving mathematics problems	3.31	0.62
Difficulty in test taking	2.94	3.66
Difficulty in understanding mathematics terms	2.51	0.81
Difficulty in presenting answers	2.62	0.86
Difficulty in following instructions	2.62	0.66
Difficulty in sequencing and completing steps	2.72	0.69
Difficulty to understand certain topics	3.21	0.56
Average	**2.70**	**1.02**

Source: Field Data, (2018)

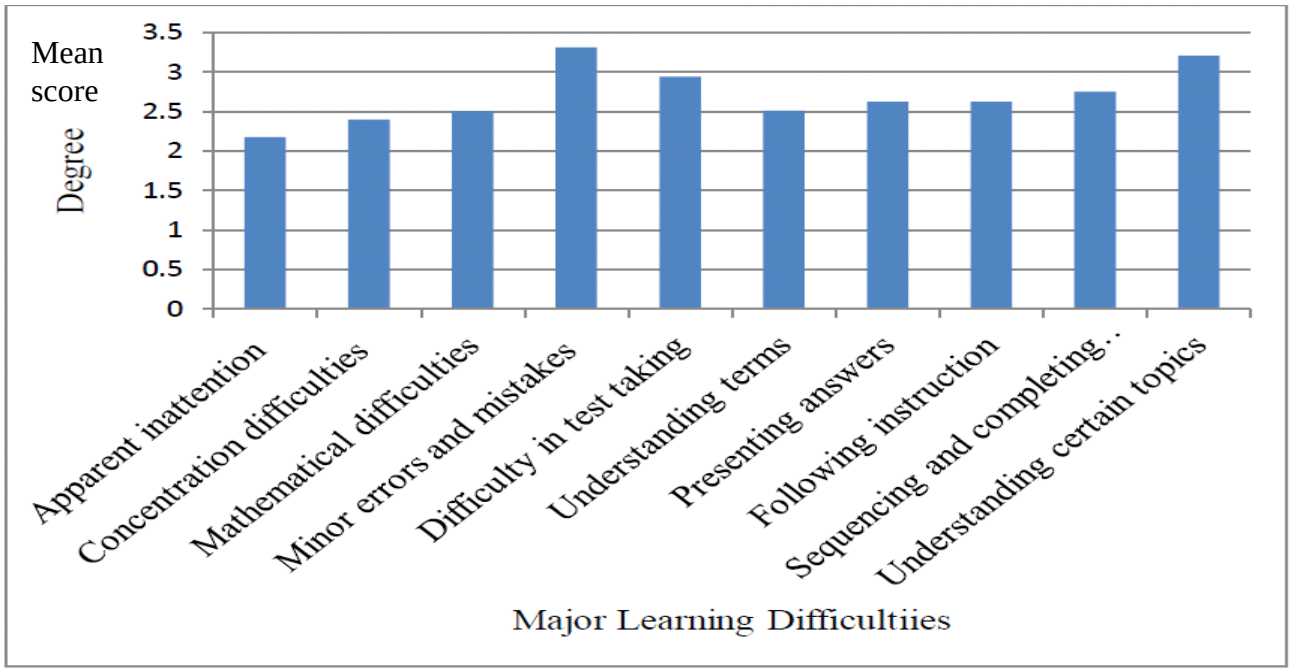
The first major learning difficulty mathematics students had was the commitment of minor errors and careless mistakes such as failure on the part of students to check their answers obtained as well as trying to do too many steps at once in solving mathematics problems which recorded the highest mean score of 3.31 as compared to an average mean of 2.70. The

extent to which mathematics teachers agreed with each other on this learning difficulty was relatively high. Thus, the associated standard deviation was 0.62. It was the second lowest standard deviation as compared to an average standard deviation of 1.02 that was reported with the learning difficulties.

With a mean of 3.21 as compared to an average mean of 2.70, the second major learning difficulty students faced was the difficulty they had with understanding specific mathematics topics such as construction, area and volume and vectors. However, there was a standard deviation of 0.56 with this mean score. This was the smallest standard deviation obtained for all the mean scores for the learning difficulties identified. This implied that mathematics teachers showed greatest agreement in respect of students' difficulty in understanding certain topics as the second major difficulty. The data indicated further that the learning difficulty with the minimum mean score was student's apparent inattention during lesson. Nevertheless, mathematics teachers' consensus on this matter was relatively low, with a standard deviation of 0.76 associated with the mean score of 2.18.

Mathematics teachers are primarily concerned about common errors students make in mathematics and their inability to understand certain mathematics topics. They however indicated that inattention in class was a minor learning difficulty that mathematics students face. The first and second major students' learning difficulties were all content-based, yet the least diagnosed learning difficulty was related to classroom management. Standards of pedagogy require that teachers should know classroom organization in order to make teaching effective. The implication for this finding is that mathematics teachers' concerns are geared towards improving their content knowledge to help students curb the problems identified. They were more comfortable with their pedagogical knowledge and its application in their teaching. However, this finding contradicts what Ji-Won (2006) and Kuchemann (2007) had that, teachers they studied had problems regarding content knowledge. They were of the view that since teachers had content knowledge difficulty, it would be very difficult for them to identify students who had learning difficulty. Shulman (1986) agreed that every effective teacher must integrate pedagogy and content into an understanding of how particular topics, problems or issues are organized, represented and

adapted to the diverse interest and abilities of learners and presented for instruction. If teachers want to be successful in their teaching, they would have to confront both issues of content and pedagogy. The bar graph (Figure 1) also presents a pictorial view about the major learning difficulties of mathematics students.



There are some topics in mathematics that students find difficult to understand. Mathematics teachers' assessment of such difficult topics is discussed using percentages in this section. Twenty-eight teachers (38.9%) indicated that area and volume, probability and construction were topics in mathematics that their students found difficult to learn. These were followed by fractions, algebraic expressions and integers of which nineteen teachers (26.4%) said their students' had difficulty in those particular topics. Fifteen teachers (20.8%) also indicated that students' had difficulty in vectors, factorization and polygons. Some teachers (12.5%) listed topics such as long division, substitution, linear equations, quadratic equation, ratio and proportion and mensuration (shapes and surface area) as

other difficult topics. However only 1 teacher (1.4%) indicated that students' have difficulty in mathematics for business mathematics.

The majority of the teachers indicated that area and volume, probability and construction are really difficult topics. This shows that indeed students have difficulty in those particular topics which are all for years 2 and 3(i.e form 2 and form 3) of the JHSs curriculum. Students might have had sound foundation in the first year, but ones they encounter problems in those topics in the upper levels, they are likely to encounter problems in their Basic Education Certificate Examination (BECE). One factor is a change of teachers. Once a teacher gives sound foundations, that same teacher is highly likely to build better on such foundations. Usually JHSs have several teachers assigned to specific classes in the various levels. So, no one teacher instructs a class throughout the entire programme of JHS curriculum.

4.2 Sources of Students' Learning Difficulties

Research objective/question 2 sought to find out the sources of learning difficulties of mathematics students. To answer this question, items 17-22 on the questionnaire asked teachers on sources of students' learning difficulties in mathematics. Their responses are presented in Table 5.

Table 5: Sources of Students' Learning Difficulties (N = 72)

Sources	Mean	Std. deviation
Students are scared of numbers	2.15	0.78
Laws and principles confuse students	2.90	0.56
Technical words confuse students	2.85	0.69
Inadequate previous knowledge	3.00	0.89
Unrelated subject relation	3.01	1.00
Large class size	3.28	0.81
Average	**2.86**	**0.79**

Source: Field Data, (2018)

Mathematics teachers agreed to the fact that a large class size hinders their ability to reach out to all students in the class. With a mean score of 3.28 which was above the average mean of 2.86, most mathematics teachers agreed with each other and rated that source as the most pervasive source of students' learning difficulty. However, their thought deviated from each other at the rate of 0.81.

The second highest source of students' learning difficulty was unrelated subject relation which had a mean score of 3.01. Its related standard deviation was 1.00. The statement "students are scared of numbers" recorded the lowest mean score as a source of students' learning difficulty. The mean score was 2.15 with a standard deviation of 0.78. Though students being scared of numbers has the lowest rating as far as the mean score is concerned compared with the other mean score, its standard deviation indicates that teachers are in high agreement that is not a major source of students' learning difficulty.

The identification of large class size by teachers as a major source of students' learning difficulties is of much significance. This is because for effective teaching and learning to go on well in the classroom, teachers should have a direct contact with their students. This will in particular help students who may have difficulties especially during the course of the teaching and learning process. Teachers' inability to reach out to all students decreases the student-teacher interaction in the classroom, thereby causing poor monitoring of students' work. This can eventually have adverse effect on students' learning. This is in agreement with what Dunn and Dunn (1978) wrote that learners are affected by their immediate environment. Supporting this assertion, Westwood (2006) also indicated that the causes of students' learning difficulty is associated with environmental factors such as large class size, noise, seating arrangement and lack of resources. They concluded that students can perform well or have better scores and positive attitudes towards a subject and be more efficient if they can move easily, relate well with their teacher and their classmates during the lesson. Penso (2002) expressed a similar view that the learning atmosphere may cause students to have difficulty in a particular subject. The class size and the overcrowding in the class room may not allow the teacher to be able to attend to all students in the cause of teaching.

On the issue of unrelated subject relation, mathematics teachers were of the view that students cannot transfer concepts or ideas gained in other subjects to mathematics. In JHS, the teaching and learning of subjects like Religious and Moral Education, Social Studies and Ghanaian Language are not related to mathematics. Therefore, students should be encouraged to pay more attention in mathematics class which will in turn improve their performance. In response to subjects studied in JHS, Madsen and Oslon (2005) made a statement that the learning of subjects such as mathematics is very dependent on the teaching being appropriate to the individual. This is because the learning of mathematics is not reinforced by lessons taught and studied in other subjects like religious and moral education, social studies and Ghanaian language. So failure to choose the appropriate teaching and learning materials and techniques to the study of mathematics makes the study of mathematics very difficult.

Within the study of mathematics itself, failure to understand a previously taught lesson makes it difficult for students to appreciate subsequent concepts. This is because students learn from the known to the unknown. The significance of previous knowledge in a lesson is a factor of sequencing in the curriculum. Yet mathematics students being scared of numbers may cause them to face a whole lot of problems such as sequencing. Mathematics as a subject deals with numbers and if students are scared of numbers, they may not be able to perform well and this may be exhibited in their inability to follow the appropriate sequencing related to the mathematics process. Chinn (2002) found out that difficulty with sequencing is another factor that may cause students to have learning difficulty. In calculation subjects such as mathematics, the sequence in which concepts are presented is important for students to understand the lessons. This therefore, implies that if students are scared of numbers and they failed to understand the previous lesson, a smooth transition to the next lesson and its understanding would be difficult.

4.3 Gender Influence for Determining the Sources of Students' Learning Difficulties

Differences in the perception of mathematics teachers regarding the sources of students' learning difficulties as influenced by their gender was ascertained. Table 6 present the descriptive statistics of teachers' perception of sources of students' learning difficulties

according to the teachers' gender. Male mathematics teachers rated large class size as a major source of students' learning difficulty with a mean score of 3.30 and a standard deviation of 0.82. Male teachers rated unrelated subjects' relation as the second commonest learning difficulties among students. The male teachers had a mean score of 3.02 and a standard deviation of 1.01 for the source.

Table 6: Distribution of Perceived Source of Students' Learning Difficulties by Teacher Gender (N = 72)

Sources	Male		Female	
	Mean	Std. deviation	Mean	Std. deviation
Students are scared of numbers	2.15	0.75	2.18	0.98
Laws and principles confuse students	2.86	0.53	3.09	0.70
Technical words confuse students	2.77	0.67	3.27	0.65
Inadequate previous knowledge	3.02	0.83	2.91	0.12
Unrelated subject relation	3.02	1.01	3.00	1.00
Large class size	3.30	0.82	3.18	0.75
Average	**2.85**		**2.93**	

Source: Field Data, (2018)

The lowest source of learning difficulty rated by the male mathematics teachers was that students are scared of numbers in learning mathematics. Male teachers had a mean score of 2.15 as against an average mean of 2.85 and a standard deviation of 0.75 for this source of difficulty.

On the other hand, female mathematics teachers rated technical words that confused mathematics students as the major source of students' learning difficulty with a mean score of 3.27 and a standard deviation of 0.65. The second highest source as agreed by female teachers was that of large class size. They obtained a mean score of 3.18 and a standard deviation of 0.75 in respect of this source of difficulty. The least source rated by female mathematics teachers was that students are scared of numbers. They had a mean score of

2.18 and a standard deviation of 0.98 in their view on this source as a learning difficulty for students.

4.4 Intervention Measures for Students' Learning Difficulties

Research question three sought to find out the intervention measures mathematics teachers employ to help address students' learning difficulties. Items 24-37 on the questionnaire were used to elicit responses in this regard. The responses of mathematics teachers are presented in Table 7.

Table 7: Interventions Employed to Address Students Learning Difficulties (N=72)

Intervention	Mean	Std. deviation
I get students' attention before I instruct them	3.19	0.52
Actively involve students	3.53	0.53
Teach specific methods of self-monitoring	3.03	0.63
Students to proofread their work	2.90	0.81
Enough time during test taking	3.04	0.66
Teaching of test taking skills	3.21	0.67
Oral testing	2.94	0.75
Clear readable and uncluttered test forms	3.06	0.63
One direction at a time	3.26	0.53
Breaking of total task into workable pieces	3.35	0.59
Example and steps to accomplish task	3.38	0.52
Adherence to laws and principles of mathematics	3.54	0.60
Remedial instructions for students with difficulties	3.18	0.66
Average	**3.20**	**0.62**

Source: Field Data, (2018)

In response to research question three, a majority of mathematics teachers agreed that mathematics teachers must emphasize strict adherence to the laws and principles of mathematics such as using sequencing ability or applying BODMAS in order for students to

see the importance of paying attention to these laws and principles. With a mean score of 3.54 and a standard deviation of 0.60, this intervention was rated the highest among all the intervention measures. Students' active participation in class was the second highest intervention measure used by mathematics teachers. It had a mean score of 3.53 and a standard deviation of 0.53. The implication of these statistics is that mathematics teachers actively involve students in instruction to help students to overcome their learning difficulties. Students should be active participants rather than dormant during instruction. Such involvement of students during teaching and learning helps them to be able to recall whatever activity that took place during instruction.

The least intervention measure that mathematics teachers used was allowing students to proofread their work before collecting them to score. Most mathematics teachers did not agree to the use of this intervention. The strategy had a mean score of 2.90 and a standard deviation of 0.81. Most teachers were of the view that the time allotted to tests and examinations was enough to enable students proofread their work before submission for assessment. Therefore, did not see the need for providing extra time for proofreading. The teachers, therefore, did not agree that it was a major intervention measure in remedying students' learning difficulties.

Mathematics teachers emphasizing strict adherence to the laws and principles of mathematics was a good intervention strategy. Before one can perform well in any discipline, one has to know the laws and principles in that discipline. Without that as a bench mark, no matter how brilliant that student is, the student cannot perform well as expected. The student who lacks knowledge of the necessary laws and principles that underpin a particular discipline always exhibits some difficulty in the learning of that discipline. Even though difficulties may be encountered in mathematics, when the student is taught the fundamental concepts, laws and principles in mathematics like algebraic properties and rules, rules of exponent, arithmetic rules of positive and negative numbers and sequencing and solving of mathematics problem by the use PEMDAS and BODMAS, the students may be prompted when he/she is faced with a problem which requires the application of these laws and principles.

The content knowledge which include those fundamental concepts, laws and principles of mathematics with the highest mean score of 5.54 was emphasized by the majority of the teachers. This implies that, they agreed to the fact that students need to get the content very well. These fundamental concepts, laws and principles of mathematics are built on at each level that mathematics is taught in the education system. The mathematics teachers were of the view that without a proper foundation, students' may have difficulty in their studies.

Students' involvements in teaching and learning activities that go on in the classroom go a long way to help students overcome the difficulties that they may encounter in mathematics. Students' participation in instructions may take the form of asking or answering questions, being called upon to make entries of a transactions on the board, project assignments, among others. Students may have the concepts, laws and principles but without their active involvement in the lesson, they may forget whatever they have been taught. Most students become very good when they are actively involved in the task at hand rather than when they are passive recipients.

Histovitch and Mitchltree (2004) explain that if teachers are able to organise and sequence their topics in such a way that they will be able to present ideas in a coherent and connective way, they will be able to solve students' learning difficulty. This is achieved when teachers are able to connect the concepts of the subjects that they teach. Jordan et al. (2005) found that teachers helped students by giving them all the possible strategies so as to be familiar with solving questions given to them. Histovitch and Mitchltree (2004) agreed that hands-on activity really helps students to perform well. The implication of this is that hands-on activity helps students to have a deep conceptual understanding of the topics being treated. Practically, when students get involved in the instruction, they tend to have a better and deeper understanding of the lesson. Westwood (2006) also supported this finding by indicating that students who have difficulty can be successful by teaching them how to learn and by also attending to matters of instruction and curriculum content.

5. Conclusions

From the findings of the study, a number of conclusions were drawn. Mathematics as a discipline is built on accuracy. Yet the major learning difficulty the mathematics students were noted to have was the commitment of minor errors and careless mistakes. The implication of this is that mathematics students are less efficient in the application of the mathematics standards to solving a particular question. The bottom line is that mathematics students will continue to experience difficulty with the subject once the problem remains unresolved.

Teachers are not able to reach out to all the students because of large class size. The problem stems from inadequate resources in both human and material needs. Since mathematics teachers are unable to give each individual student the desired attention, there is always the room for students' work to go unsupervised and thus promoting and compounding students' learning difficulties. Due to the limited attention mathematics students receive from their teachers, the students are likely to continue to perform abysmally.

Generally, mathematics teachers employ multiple intervention measures to address students' learning difficulties. This implies that mathematics teachers are not leaving out students' difficulties unattended but rather are holistically addressing them. Yet, since they employ limited strategies in identifying mathematics students' learning difficulties and thus the high propensity of misdiagnosing students' learning difficulties, there is also the possibility of applying the inappropriate interventions. This may have a weakening effect on the performance of the mathematics students.

Most literature indicated that causes of students' learning difficulties were associated with lack of teachers' knowledge, nature of the subject, inappropriate teaching methods etc. Many of such studies (Chinn, 2002, Ji-Won, 2006, & Penso, 2002) confirmed this cause of students learning difficulties. This study has revealed that teachers are not able to reach out to all the students and address individual students' problems because of large class size resulting to an abysmal performance in mathematics. The study has indicated that mathematics teachers entreat students to adhere strictly to the mathematics laws and principles. Teachers actively

involve their students during teaching and learning and also break task into manageable pieces as ways of addressing the difficulties that mathematics students encounter.

6. Recommendations

Based on the findings and the conclusions drawn, the following recommendations were made for practice:

1. Carelessness was found to be the major learning difficulties JHS mathematics students have. It is therefore recommended that mathematics teachers become extra careful and methodical in presenting facts in class. They must ensure that students are attentive to details and stick to formalized presentation of factual information and figures in mathematics. It pays for the teachers to go around supervising the work of students as they perform an activity in class so as to ensure that a timely intervention could be provided when the students are going wayward.
2. It is recommended that the government of Ghana provides additional school blocks in order to break the large classes into smaller units so as to facilitate student-teacher interaction to promote learning.

3. The common intervention mathematics teachers' use to address mathematics students' learning difficulties is their cautioning the students to strictly adhere to the principles and laws of mathematics. Caution alone may not be potent enough to get students to do the right thing. Students must know the nature of mathematics and appreciate the need to understanding and translating their understanding into solving mathematical problems in examinations. Mathematics teachers and school administrators must assist students to have that intrinsic motivation to study the subject.

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