

CHAPTER TWO

INNOVATIVE INSTRUCTIONAL STRATEGIES FOR TEACHING PERCEIVED DIFFICULT TOPICS IN MATHEMATICS

Adijat S. AMEEN, Ph.D.

Introduction

Mathematics is a core subject in Nigerian secondary schools. The study of the subject was established in Nigerian schools in order to produce competent persons who are skillful in the application of mathematical knowledge to solve everyday life problems. Mathematics is also relevant to decision-making process. The Nigerian national policy document on education (FRN, 2013) shows that improvements in the teaching and learning of Science, Technology and Mathematics (STM) is necessary in order to create the basis for technologically sound workforce in line with the nation's developmental needs (Onwuachu & Nwakonobi, 2009).

Fajemidagba and Adegoke (2008) defined Mathematics as a logical development which is made up of undefined terms, principles of logic and logical conclusions that follow from the hypothesis. According to the scholars, the logical conclusions make no claims concerning absolute truth or falsity. Mathematics is also a body of knowledge essential for the achievement of a scientific or technological nation.

Despite its importance to the mankind and nation at large, the poor performance of students recorded annually in both external and internal examinations in Mathematics has been a great concern to stakeholders in Nigeria. Gimba (2013) reported that students' poor performance is traceable to a number of factors such as students' interest, teaching methods, class size and teachers' inadequate understanding of basic concepts in Mathematics. Also, Kolawole (2007) had earlier reported that students' poor performance in Mathematics is hinged on inadequate understanding of some concepts in Mathematics by the students, poor methods of teaching as well as the high degree of complexity and abstractedness of some concepts in Mathematics.

Researches in Mathematics Education have identified some perceived difficult concepts in the new senior school Mathematics curricula. This refers to contents in the new Mathematics curricula found to be difficult to teach by Mathematics teachers and also found to be difficult to understand by students and are failed in external and internal examinations (Ameen & Salman, 2016). These concepts include: bearing, differentiation and applications, integration and application, logical reasoning among others. Azuka, Jekayinfa, Durojaiye and Okwuoza (2013) also reported that all the newly added topics to Mathematics curriculum are perceived to be very difficult to teach by Mathematics teachers. Such topics include Logical reasoning, Geometric

construction, Financial Mathematics, Integration and applications, Differentiation and applications, coordinate Geometry, Bearing and Modular arithmetic.

The researcher looked at various innovative instructional strategies that can be used to teach Mathematics and therefore, the topic identified as difficult concepts can be made easier to teach and learn by the teachers and students respectively. Also, students' performance can be improved upon through the suggested innovative instructional strategies that were discussed.

Innovative Instructional Strategies in Mathematics Education

Previous studies such as Harbor and Peter (2002) and Iji (2005) have identified teaching methods and strategies used by teachers in their classrooms as one of the root causes of undesirable poor performance in Mathematics. In addition, the traditional mode of delivering instruction to students was found not to produce desired learning outcome.

Therefore, there is need to incorporate innovative instructional strategies that would improve students' performance in the subject. Innovative teaching strategies are combination of methods used by the teacher to translate a complex or an abstract theory in the classroom to a real-life reality based on experience in order to ensure that learners understand what is taught easily (Sulyman & AbdulSalam-Nuhu, 2016). Innovative teaching also means that students seek information with their own efforts without the teacher giving the answers to all their questions. It is when teachers enrich the lesson by using different methods of teaching in order to enhance students' understanding of the concepts that is when there can be improvement in students' performance and consequently bring out the desired learning outcomes.

Khurshid and Ansari (2012) reported that innovative teaching strategies promote students' academic performance and reduced boredom among pupils of primary school. Some of these innovative instructional strategies that can be used to improve students' performance and the topics perceived to be difficult to understand by the students include: guided inductive inquiry, task analysis model, guided discovery strategies, cooperative learning, inquiry teaching, concept mapping, Problem-solving strategies, Demo-kit strategies and uses of technology.

Cooperative Learning Strategy: This involves organising students in small groups assigned with academic and social learning experiences. Each group comprised of students with different levels of abilities exposed to a variety of learning activities that would improve their understanding of Mathematics. Each member of a group is responsible, not only for learning what is taught, but also for helping group mates to learn, therefore, creating an atmosphere for better performance.

The positive outcomes of the strategy are: it promotes meaningful learning among learners; increase students' retention; enhances students' satisfaction with their learning

experience; helps to promote students' self-esteem and helps to increase positive race relations among the students.

Cooperative learning has some limitations that could prevent effective implementation of the processes involved. For instance, Sharan (2010) suggested that the constant changing of cooperative learning strategy can make teachers who use this strategy to become confused and lack complete understanding of the method. There can also be resistance and hostility from the students who believe that they are being held back by their slow learners' teammates or by students who are less confident and feel that they are being ignored by their team.

Guided Inductive Inquiry: This is a learning process where by students were provided specific facts or ideas by their teachers while students were expected to make generalisations from it. The role of the teacher is to guide students toward developing logical reasoning skill that is required to solve mathematical problems. Also, the teacher is seen as a questioner and not a problem solver. Hence the teacher spends most of the time interacting with the students but providing few answers when necessary (Donald, Robert, Richard, Michael & Abbie, 2010).

The limitation of the strategy is that when it is not properly guided, students might go out of the context and there will be no meaningful learning.

Guided Discovery Strategy: The teaching strategy involves learning through explorations but with directions from the teacher. The teacher devices series of statements or questions that will guide the learner, step by logical step, making series of discoveries that lead to a predetermined goal. According to Robert (2009), discovery strategy is a constructivist approach to teaching in which students are encouraged to discover principle in Mathematics by themselves through guided discovery process.

The strategy is advantageous because learners build their own knowledge, instruction is student centered, it inculcates manipulative skills, retention, recall and transfer of knowledge is facilitated. Its limitation is that it is time consuming, slow, costly and difficult for teacher's intensive supervision particularly in large classes.

Task Analysis Model: This strategy involved the process of subdividing the content, concepts or processes of a lesson into smaller and sequential steps that always begin with the least complex and progress to the most complex. The process of breaking tasks or objectives down into their simpler components is called task analysis. In this strategy, the teaching of a new skill require that the teacher is aware of the sub-skills involved in the concept to be taught and to be certain that students know what they need to know. Therefore, it is important to consider all the sub-skills that revolve around the main skill such as think of all the separate steps involved in long division of the concept of Mathematics to be taught.

Demo Kit Strategy: The demo kit strategy is another innovative teaching strategy for teaching difficult concepts in Mathematics. It helps to enhance students' learning and achievement and by producing a learner who knows how to learn, a self-regulated learner and a learner capable of applying what is learnt. The use of demonstration kits in study technology provided a way to use manipulatives to check understanding by having the students to manipulate paper clips, erasers, objects, etc. as symbolic representations of concepts. The teachers provide the kit or ask the students to get a demo kit. A demo kit is a collection of things such as rubber bands, paperclips, corks, pen tops, thumbtacks, erasers, etc.

A student is supposed to 'demo' a concept by choosing several objects by assigning them significance and verbalising or physically demonstrating the relationships between them (Touretzky, 2013).

Problem Solving Strategy: This involves students learning about a concept or topic by solving problems. Students identify what they already know and how and where to access new information that may lead to resolution of the current problem. The role of the teacher is to facilitate learning by supporting, guiding and monitoring the process.

Concept Mapping: concept maps are tools for organising and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type and relationships between concepts or propositions between two concepts. According to Novak (2008), concepts should be represented in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and more specific, less general concepts arranged in hierarchical order.

Use of technology: The importance of using technology for Mathematics teaching and learning cannot be overemphasised; it is argued that technology evolution has been a driver for reform in Mathematics teaching and learning (Chang, 2011). Due to expulsion of technology, there have been different innovative instructional packages and Computer Assisted Instruction (CAI) which can be used for effective teaching of perceived difficult topics in Mathematics.

Advances in online tools can be used in an innovative manner for enhancing students' experience of Mathematics teaching and learning and for enabling students' autonomy in the learning process. Specific online learning services provide support for Mathematics instruction in higher education, such as MyMathLab (www.mymathlab.com) and ALEKS (Assessment and Learning Knowledge Spaces, www.aleks.com). MyMathLab enables educators to design a customizable e-learning module that contains many useful features, such as interactive assignment exercises with guided solutions, personalised study plan, multimedia aids including videos of lectures and animations, assessment managers for editing tests and quizzes, and a grade book that automatically tracks students' results. ALEKS is an online assessment and

learning system that utilises artificial intelligence algorithms for adaptive assessment of a student's knowledge of the course (AbdulWaheed, Jaworski & Crawford, 2012).

Matlab is used for in-class activities that demonstrate linear algebra concepts (Chang, 2011). Matlab/Simulink and LabVIEW have been used for designing illustrative examples of differential equations in an engineering Mathematics course (Pennell, 2009). GeoGebra is used to promote inquiry and facilitate conceptual understanding of students in a first year university Mathematics course for engineering students (Jaworski, 2010; Jaworski & Matthews, 2011). Formative assessment can be facilitated to a great extent using computer algebra tools such as MapleTA.

Conclusion

It can be concluded that teaching of perceived difficult concepts or topics in Mathematics using all the aforementioned strategies will not only make the learning easy but also clear the grey area or misconceptions students might have in learning Mathematics.

Suggestions

It is suggested that stakeholders in education such as teachers, heads of schools, policy makers and government agencies should encourage teachers to make use of these innovative instructional strategies in order to make the teaching and learning of difficult concepts easy in Mathematics. In-house seminar and training for Mathematics teachers should be organised by the authority concerned this will enhance the knowledge of Mathematics on the innovative instructional strategies.

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