REDUCING LEARNING DIFFICULTIES IN SENIOR SECONDARY ONE (SSI GEOMETRY USING 5E- LEARNING CYCLE MODEL (L.C.M.)

BY

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Abstract

Mathematics skills are necessary for the success in primary, higher level and everyday life of every individual. It remains an indispensable tool that enhances technological development, though students still perform poorly in mathematics. The study observed that prominent among the causes of poor students' achievement in mathematics in external examinations is their inability to attempt questions in geometry. This was based on reports from Chief examiners of mathematics to that effect. This poor achievement of students was traced to the teaching methods adopted by mathematics teachers in secondary schools. The conventional teaching method which has made the learning of mathematics difficult for students was still observed as a popular teaching method in Nigeria mathematics classrooms. This necessitated the search for a better teaching method. This paper focuses on reducing learning difficulties in SSI geometry using of 5E-learning cycle model (L.C.M.) as a better teaching method. Brief explanation of 5E-L.C.M. was given based on its five phases, then the content and activities that will reduce learning difficulties in SSI geometry in the classroom were presented using sample lesson plans with emphasis on the area of a sector and area of a segment. The study was aimed to share with fellow mathematics facilitators, practical experiences with 5E-L.C M. for teaching geometry so as to reduce students' learning difficulties and increase their achievement in geometry.

Keywords: Mathematics, Geometry, Learning Difficulty, 5E-L.C.M, Senior Secondary School

Introduction

Mathematics being a science of numbers is used in everyday life across all ages. Knowledge of Mathematics is utilized in the calculation of time, distance, handling money and analyzing data etc with the focus of making financial decisions to mention but a few. Mathematics for this reason is adopted as a core subject taught in primary and secondary schools to equip the pupils and students for higher thinking skills (Federal Republic of Nigeria (FRN), 2004).

Despite the relative importance of Mathematics, students' achievement in the subject in both internal and external examination has remained consistently poor. This weakness has however, been found to be more in the area of Mathematics referred to as geometry (WAEC Chief Examiner's Report 2010 – 2014). The word 'geometry' comes from two ancient Greek words, 'ge' and 'metria' ge means earth while metria means to measure. It comprised those branches of Mathematics that exploit visual intuition which are the most dominant of our senses to remember theorems, understand proof, inspire conjecture, perceive reality and give global insight (Royal, 2001). Inclusion of geometry in the school curriculum contributes to helping students develop skills of visualization, critical thinking, intuition, problem solving, deductive reasoning, logical argument etc. Geometric representations can be used to help students make sense of other areas of mathematics: fractions and multiplications in arithmetic, the relationships between the graphs of functions (of both two and three variables), and graphical representations of data in statistics.

Geometry is a wonderful area of mathematics to teach. It is full of interesting problems and surprising theorems. It is open to many different approaches and has a long history, intimately connected with the development of mathematics. Geometry is an integral part of life from architecture to design in all its manifestations. As a result, it can be a topic that captures the interest of learners, often those learners who may find other areas of mathematics, such as number and algebra, a source of bewilderment and failure rather than excitement and creativity. Teaching geometry well can mean enabling more students to find success in mathematics. These aspects and considerations also tend to make geometry a demanding topic to teach well.

Teaching geometry in a way that stimulates curiosity and encourages exploration can enhance students' learning and their attitudes towards mathematics. Mathematics, especially geometry demands that teachers should be highly innovative in teaching the subject in other to reduce its learning difficulties. These learning difficulties in mathematics and geometry in particular can manifest in a number of different ways as thus:

i Anxiety around mathematics
ii Language- related problems
iii Different forms of representation
iv Lack of prompt feedback
v Inability to understand mistakes (Belanger, 2016)

Reducing anxiety around mathematics, demands that teachers create calmer, conductive and safer learning environment. These they can achieve by avoiding giving surprise mathematics tests and quizzes to the students, not displaying their marks, making it safe for students to make mistakes and developing trust with students. All these must be accompanied by presenting one step at a time during teaching.

In order to reduce language-related problems, teachers can ensure that students understand complex vocabulary by providing illustrations to support their words. Teachers can equally learn to teach the terms used to describe various operations systematically like add, sum, withdraw, deduct, less, separate etc. or synonymous like surface, area, floor, coverage etc. Teachers can equally reduce learning difficulties in mathematics as regards language-related problems by summarizing aloud or by reading aloud.

Teachers can also reduce learning difficulty in teaching geometry by offering students variety of forms of representation as oral examples are rarely enough to enable students form clear mental images of the concept in focus. With the practice, students can gradually develop representation when given opportunities to manipulate materials especially in geometry classroom. Students can use three-dimensional solid objects and build two-dimensional objects out of cardboard.

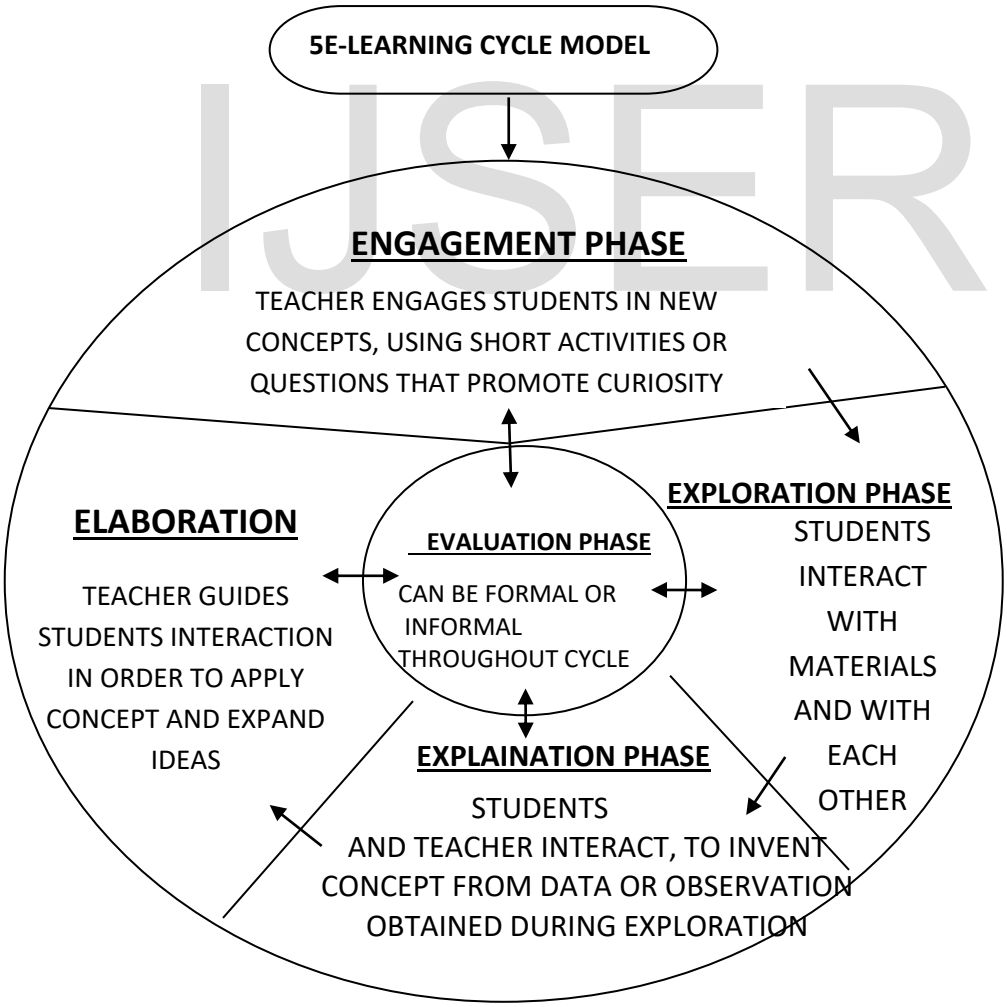
This calls for assimilation of mathematical skills and retention. Also manipulating beads, blocks straws and materials designed for teaching fractions will equally reduce their learning difficulty. Most importantly, learning geometrical facts by rote is extremely difficult, so mathematics teachers should allow their students to use tables and even calculators as a way to ease their mental load and provide them with the opportunity to learn in variety of ways.

Learning difficulties in geometry can be reduced if teachers provide feedback promptly to the students during classes. When learning, students draw many different forms of knowledge and processes, however, unless they receive feedback promptly, they may have difficulty managing the processes and staying motivated. For instance, introducing a new geometrical concept might destabilize the students; the teacher in trying to reduce the difficulty can plan the lesson in such a way that she/he spend time near the students, creating an atmosphere of trust and support the students in this new learning. Likewise when consolidating learning, if mathematics teachers are unable to provide prompt feedback, they may team the students up with the higher-performing students to make correct answers available promptly to avoid difficulty or use exercises on a computer that provide immediate feedback tracked from mathematics websites.

Finally, mathematics teachers should reduce this difficulty in geometry teaching and learning by making the students understand mistakes and that it should not be seen as a crime or avoided totally. Teachers should use the mistakes their students make to shed light on misconceptions and inadequate processes. They can equally use the students' mistakes to model their cognitive strategies that are very useful for working independently.

The aforementioned learning difficulties with the process of reducing them in geometry classes can still be reduced to the barest minimum on application of an innovation teaching strategy like the 5E-L.C.M. especially in SS1 which is the foundation of senior secondary classes. 5E – L.C.M. is an integration of various teaching methods as it presents a concept through five ways pathways that enhances learning. The learning cycle mode has its foundation on Jean Piaget's Theory of knowledge. Its name comes from the number of its phases and initials of each phase. These phases are Engage/Enter, Explore, Explain, Elaborate, and Evaluate (Hokkanen, 2011)

- Engage is where the teacher engages the students in a new concept using short activities or questions that promotes curiosity and draws prior knowledge.
- Exploration phase is all about students conducting activities and group discussions to explore questions and implement preliminary investigations.
- Explanation phase calls for the teacher to track their correct and incorrect responses during presentation and with adequate explanations using series of examples.
- Elaborate is where students try to advance their newly structured knowledge into deeper and broader understanding.
- Evaluation phase demands that the teacher assesses students' comprehension and ability in accomplishing the educational objectives.

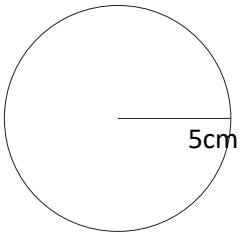


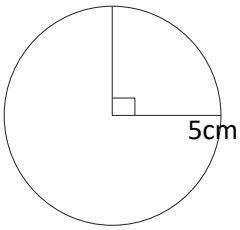
5E-L.C.M. SCHEMATIZED (OKAFOR, 2016)

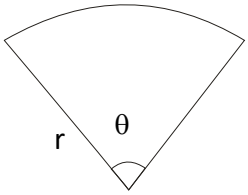
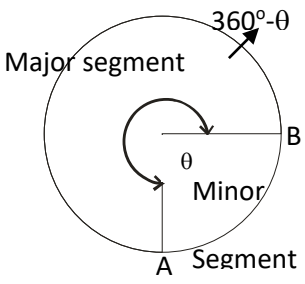
The above phases seem not to be followed when conventional method is applied in teaching which is reflected in mass failure of students in external examinations and equally do not empower them to become deep thinkers, who are capable of making discoveries and solving complex problems especially in geometrical part of mathematics. This study noted several research evidences (Balci, 2005; Johnson & Marx, 2009) in favor of 5E-L.C.M. though in other countries and in other science subjects and its set to apply that in the sample lesson plans on geometrical concepts below to enhance reduction in learning difficulties in SS1 geometry.

LESSON 1

Topic: Area of sector
Duration: 40 minutes lesson.
Strategy: 5E-Learning cycle model
Instructional Objective: By the end of the lesson the students' should be able to (i) Calculate the area of the minor and major sector. (ii) Participate fully in matters concerning sectors. (iii) Construct a sector.
Instructional Material: New General Mathematics SS1, Sketch of a sector.
Entry Behaviour: The teacher tests their entry behaviour by asking the students' in turns the following questions. (1) Draw a segment (ii) State the formula for calculating the perimeter of a segment
Set-Induction: The teacher induces set by asking the students' to form two sectors of unequal sizes from a circle.

LESSON	CONTENT	5E'L.C.M. PHASE INVOLVED	TEACHER'S ACTIVITES	STUDENTS' ACTIVITIES
1	Area of sector	I Engage	The teacher started by asking them to 1.Draw a circle with radius 5cm. 2.Draw a sector such that its radius is 5cm and its subtended at an angle of 90^o	The students' draw the circle as thus. 

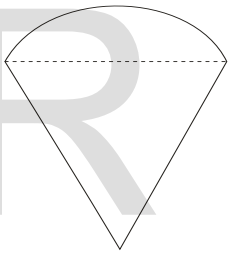
			The students' proceeds according to the teacher's direction and comes up with the sketch below 
		The teacher then asks them to use a razor blade and carve out the drawn sector, and attempt inserting it into a circle starting their observations.	The students' attempt carving the drawn sector and equally trying inserting it into the circle, stating their observations.
	II Explore	The teacher then asks them, how many of such sectors can they discover in a circle and judging by the angle subtended at the centre of each of the sectors.	The students' are encouraged to explain this relationship in their own words, as they insert the carved out sector to identify the number of sectors inside the circle. This they achieved judging by the angle subtended at the centre of the sector as directed by the teacher.
	III Explain	They teacher then ask them the relationship between the sum of angles of a circle and that of a sector. Based on their responses, the teacher	The students' attempts the teachers' questions while seeking for new explanations as the go on to explain thus, since the sum of angles in a circle 360^{o} and that

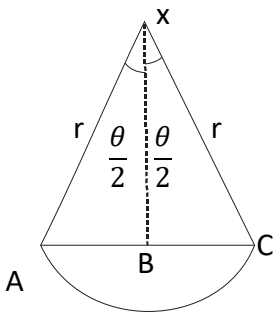
		then goes on to clarify that since they are of the same radius and the circle makes an angle of 360^o while the sector makes and angle of 90^o, then the sector is $\frac{90}{360}=\frac{1}{4}$th the circle.	of a sector equal 90^o therefore $\frac{90}{360}=\frac{1}{4}$th the circle.
		The teacher asks them to sketch a sector of radius r and angle of inclination θ and to quote the area of a circle.	The students' attempt the teacher's questions' and comes up with the sketch below.  The students' quote the area of a circle as πr2.
		The teacher then explains to them that if the area of circle is πr^2 and the sector sketched subtends angle θ its area=$\frac{\theta}{360}X\pi r^2$.	The students' listens attentively and note the teacher explanations asking question where they are confused.
	IV Elaborate	The teacher extends the concept further by asking them to sketch a circle indicating the major and the minor sectors formed.	The students attempt the sketch as directed by the teacher having the sketch shown below.
		The teacher leads them to discover that the area of the minor sector =$\frac{\theta}{360}$ of the area of a circle.	

		i.e. $\frac{\theta}{360} X \pi r^2$ While the area of the major sector $=\frac{360-\theta}{360}$ of the area of the circle. i.e. $\frac{360-\theta}{360}$ X πr^2	The students' derive the formulas alongside asking questions where they are confused.
	V Evaluation	The teacher picks some evaluation questions from their text including the one stated below: Calculate the area of the minor and major sector subtended at an angle of 100^o if its radius is 3cm. Based on their answers the teacher does the corrections while emphasizing the main points and finally asked them to prepare and submit a model of a sector.	The students' jots down the teacher's questions and attempt it. They equally share ideas with each other assessing their level of understanding based on their scores. They also copy their assignment which is the construction of a model of a sector in readiness for the next lesson.

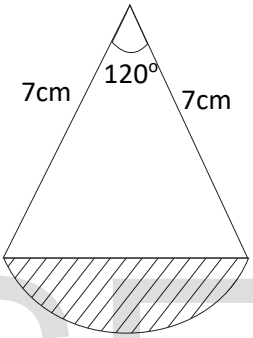
LESSON 2

Topic: Area of a segment.
Duration: 40 minutes lesson
Strategy: 5E-Learning Cycle Model.
Instructional Objective: By the end of the lesson the students' should be able to (i) Determine the area of a given segment. (ii) Sketch a sector indicating the portion that is the segment. (ii) Answer questions based on segments.
Instructional Material: New General Mathematics SS1, Sketch of a segment and Mathematical set.
Entry Behaviour: The teacher tests their entry behaviour by asking a student to sketch a sector, identifying its components.
Set-Induction: The teacher induces set by displaying charts of a sector with parts demarcated with dotted lines.

LESSON	CONTENT	5E-L.C.M. PHASE INVOLVED	TEACHER'S ACTIVITIES	STUDENTS' ACTIVITIES
2	Area of segment	I Engage	The teacher engaged the students with the following questions: 1.Draw a sector 2.Using dotted lines divide the sector into two principal components?	The students attempt drawing a sector as directed by the teacher.  They equally divided the sector into two principal components individually. The teacher goes round, correcting them where needs be. The activities stimulate students' curiosity and encourage them to ask their own questions.
		II Explore	3.What are the names of the two components?	Students' differently attempted the names of the two components. They have hand-on-activities suggesting

		the names as a triangle and a segment.
	The teacher from their answers offers corrections where necessary.	
	The teacher calls the students' in turns to split the shape into two on the board.	The students' comes out in turns, attempting the sketch on the board as directed by the teacher.
III Explain	The teacher then asks them the implication of the above assertion. Based on their response the teacher confirms the area of a sector as=Area of Triangle + Area of segment. Implying that Area of segment=Area of sector-Area of triangle.	The students 'share ideas with each other and with teacher who provides an explanation. They students' were able to identify that area of a sector = area of triangle + area of segment. The equally noted the teacher's explanations.
	The teacher asks the students' to draw a sector, denoting the segment and dividing the inclined angle into two using a perpendicular.	The students' attempts the teacher's questions and arrive at the sketch below after correction by the teacher. 

	Using the sketch the teacher asks the students' to derive the formula for SIN$\frac{\theta}{2}$ and Cos$\frac{\theta}{2}$ applying SOH, CAH, TOA.	The students' applying SOH, CAH, TOA arrive at the following with guidance of the teacher SIN$\frac{\theta}{2}$ = $\frac{AB}{r}$$\Rightarrow$AB=rSin$\frac{\theta}{2}$ But AC=2AB= 2rSin$\frac{\theta}{2}$ And Cos$\frac{\theta}{2}$=$\frac{XB}{r}$ $\Rightarrow$XB=rCos$\frac{\theta}{2}$
IV Elaborate	The teacher also asks them to determine the area of a triangle.	The students with the guidance and questions from the teacher determines the area of a triangle thus: =$\frac{1}{2}$base X height =$\frac{1}{2}$ 2rSin$\frac{\theta}{2}$$XrCos\frac{\theta}{2}$ =r^2 Sin$\frac{\theta}{2}$$Cos\frac{\theta}{2}$ Noting that Sin$\frac{\theta}{2}$Cos$\frac{\theta}{2}$=$\frac{1}{2}$$Sin\theta$ Hence r^{2}Sin$\frac{\theta}{2}$ Cos$\frac{\theta}{2}$ = $\frac{1}{2}$r^{2}Sinθ ∴Area of the triangle=$\frac{1}{2}$r^{2}Sinθ
	The teacher now asks them to recall the formula for area of a sector and determine the area of a segment.	The students' recall the area of a sector as =$\frac{\theta}{360}$Xπr^2 Then applying the formula they initially had on determining the area of a sector based on its components, they determine the area of a segment as Area of sector- Area

		of triangle= $\frac{\theta}{360}X\pi r^2$- $\frac{1}{2}r^2Sin\theta$.
Evaluate	The teacher evaluates the lesson using the question below and goes round to correct as the students' attempts it in the class.  Determine the area of the shaded portion. The teacher equally asked them to come to class next lesson with their sugar cube.	The students' solves the questions given to them by the teacher and assesses their abilities based on their solutions. They equally noted the teacher's assignment.

Conclusion

The paper reveals that reducing learning difficulty in geometry for greater students' achievement demand that teachers should apply innovative methods like the focused 5E-L.C.M. The displayed sample lesson plans showed how 5E-L.C.M. can be used to reduce learning difficulty in geometry. Teachers are therefore expected to take advantage of the phases involved in 5E-L.C.M. as it makes the lesson easier for the students, resulting in attainment of objectives and thorough coverage of the scheme by the teacher.

Recommendations

Sequel to the study, the following recommendations were made:

1. Curriculum planners should incorporate the phases of 5E-L.C.M. in the curriculum for teacher education in the country so as to popularize its use and enhance greater students' achievement.
2. Government should also release fund for the training of pre-service and in-service teachers in the skills for implementation of 5E-L.C.M. in teaching, in order to reduce students' learning difficulty in geometry.
3. Better condition of service should be provided for teachers to enable them explore and embrace innovative techniques willingly.

References

Balci, S. (2005).Improving the 8th grade students' understanding of photosynthesis and respiration in plants by using 5E-learning cycle and conceptual change text. *Unpublished Master's thesis:* Ankara: Middle East Technical University.

Belanger,N. P. (2016). Understanding developmental dyscalculia: A math learning disability. *LD*

@schoolwebsite

Federal Republic of Nigeria (2013). National policy on education (4th Edition). Lagos: NERDC Press.

Hokkanen, S. L. (2011). Improving students Achievement, Interest and Confidence in Science through the Implementation of the 5E Learning cycle in the middle grades of an urban school. *Ms Thesis*. Bozeman : Montana State University.

Johnson, C. & Marx, S. (2009). Transformative professional development: A model for urban science education reform. *Journal of Science Teacher Education*, 20, 113-134.

Okafor, C. F. (2016). Effect of 5E- learning cycle model on senior secondary school students' achievement and retention in geometry. *Ph.D. Thesis*. Nsukka: University of Nigeria.

Royal, S/J.(2001). Teaching & learning of geometry: *London Royal Society/ Joint Mathematical Council*. London, 11-19.

West African Examination Council (2010-2014). *Chief Examiners Report (Nigeria) SSCE May/June Examinations.*