SCIENCE AND DEVELOPMENT

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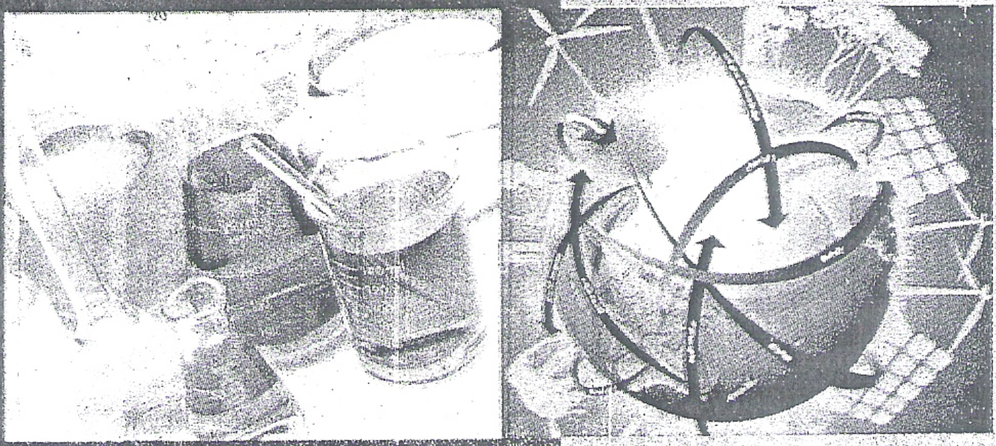

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Cognitive Concepts Maps and Problem Solving in Mathematics-Science Education

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Abstract

The paper examined the cognitive concepts maps and problem solving in mathematics-science education *in some selected public secondary schools in Ojo Local Government Area of Lagos State. As an Expost-facto research study fifty-eight SS2level students and ten mathematics teachers were purposively sampled from 5 randomly selected schools in Ojo local government area of Lagos State. Two instruments used were cognitive concepts maps in mathematics and mathematics-science problem solving test with reliability co-efficient of 0.72 and 0.75, respectively. Three hypotheses were raised and tested at 0.05 levels of significance. Findings revealed that there is a significant difference between teachers 'understanding of cognitive concepts maps in mathematics and students' problem solving in mathematics (t-cal>t-val, df=66; P<0.05), there is significant relationship between teachers 'understanding of cognitive concepts maps in mathematics and male students' problem solving in mathematics (t-cal>t-val, df= 38; P<0.05), there is significant relationship between teachers 'understanding of cognitive concepts maps in mathematics and female students' problem solving in mathematics (t-cal>t-val, df=36, P<0.05. As a result, conclusion and implication of the study was discussed in line with science education and development with recommendations proffered.*

Key words: Cognitive, Concepts-maps, Mathematics-science, Problem-solving.

Introduction

Over the years the performance of mathematics students in the educational system in Nigeria has been under criticism. Nationwide criticism of the 'falling standard' of education led the federal government to convene a national conference of secondary school principal to find solutions to the educational problems (Aramide, 1997). The Nigerian government, desirous of achieving scientific and technological advancement has introduced a number of innovative policies and practices aimed at encouraging the effective learning of mathematics in schools. To achieve this laudable policy, government invested huge sum of money at improving the teaching and learning of mathematics. However, these investments have not produced the expected returns in terms of student's performance in mathematics. This is evident in the West African Examination Council results released within the period of 1988 to 2009 in mathematics and science subjects. Though the poor academic achievement has been observed in all secondary school's subjects despite government's investment towards enhancing the teaching and learning, and necessitated various technology awareness and programmes set-up as an intervention strategy to combat the menace, yet the situations have not been improved. Studies conducted by various scholars (Bature and Bature, 2005; Obioma & Ohuche, 1990; Ogunyemi & Bettie, 1977) and science (Okebukola, 2004; Ajewole, 1999; Oke, 2003; Soyinbo, 2006) on students' performance in mathematics and sciences have shown that there is a declining performance in the West Africa School Certificate Examination in these subjects. Mathematics as a bedrock of science cannot be debated for it is an intellectually stimulating discipline for the technology development of any nation. It plays a vital role in biology, physics, geology, chemistry, architecture and even in banking and medicine, as it is an indispensable subject either.

However, the study of this all-important subject has been creating problems from time immemorial as students have continued to fail the subject's en-mass without justification going by government's huge investment on its teaching and learning. Many researchers have proffered one solution or the others but perennial problem continues unabated. It thus appears that there is a need to give serious attention of the teachers' understanding of the cognitive concepts and students' problem solving in mathematics-science education as an alternative means of combating the problem. Concept in science according to Abdulahi (1992) is the meaning given to a scientific term. Many concepts are found in the discipline of mathematics, but the understanding of which can help in providing the mystery cloak around (mathematical) science. Concept maps are structured visual means of representing concepts and their inter-relationships. The use of concept maps in science is not a new affair as it is listed among the innovations used in science (Odegwu, 2001). It helps the learner to understand the link between concepts, and provides the learner with systematic summary of what is to be learnt. Concept maps also lead to sustained discourse on the topic (Kolawole and Oluwatayo 2005). The understanding of concepts helps the learner to improve on his or her cognitive organization (Asuka, 2005). Different people have defined mathematics differently, and this perhaps may due to its diversified function, in the day-to-day activities of the man. According to Osafehinti (1990), the prosperity of any country depends on the volume and quality of mathematics offered in its school system. The tool which enhances man to knows how many, how large part, in what direction, with what chances are very useful in the formation of an educated man, According to Adetokunbo (2005) mathematics was perceived as the field of study of size, numeration and relations between them. Also, Mathematics is descriptive that deals with abstract quantities, order or structure of human investigation. By and large, the usefulness and importance of mathematics in making a society self-reliant nation cannot be overemphasized. This suggests why government, as enunciated in the National Policy on Education (2004) that it should be taught compulsorily at both primary and secondary levels of education. As a result, one wonders if teachers actually understand the cognitive concepts maps and problem solving in mathematics-science education.

Statement of the problem

The study examined the cognitive concepts maps and problem solving in mathematics-science education in some selected public secondary schools in Ojo Local Government Area of Lagos State. Specifically, the study sought answers to the understated research hypotheses:

H_{o1}: There is no significant difference between teachers 'understanding of cognitive concepts maps and students performance in problem solving in mathematics-science education.

H_{o2}: There is no significant difference between teachers 'understanding of cognitive concepts maps and male student's performance in problem solving in mathematics-science education

H_{o3}: There is no significant difference between teachers 'understanding of cognitive concepts maps and female student's performance in problem solving in mathematics-science education.

Methodology

As an *Expost-facto* research design, population to the study comprised of mathematics teachers and SS3 students of public senior secondary schools in Ojo Local Government Educational District of Lagos State. Using a purposive sampling technique fifty-eight SS2 students and ten mathematics teachers were chosen for the study. Instruments used were Cognitive Concepts Maps (CCM) for mathematics teachers and Mathematics-science Problem-solving Test (MPT) for the students. The CCM contained a-30 items questions on cognitive concept maps of topics at SS 2 levels though patterned in form of a 4-Likert format, while MTP was an adapted past West African Examination 20-Questions on cognitive concepts that were revised into problem solving form. The instruments were given to 3 mathematics teachers and 2 experts in mathematics education with verse knowledge in test construction to ensure their content validity via test-retest method. The CCM was later administered to three mathematics teachers and MTP to ten SS2 students that were not part of the main study to ensure their internal consistence and avoid ambiguities of responses within an interval of two weeks. The responses obtained from the administration of these instruments were subjected to product moment correlation which in turn gave the correlation coefficients of 0.72 and 0.75 for CCM and MTP, respectively.

The two instrument used were questionnaire and achievement test. The questionnaire contains mathematics concepts that sought for respondents understanding of classifications across the cognitive domain of knowledge. The second instrument used was achievement test to solicit information from the same respondent (student) on basic understanding of mathematics problems as corresponds with their basic understanding of contents classification into cognitive domain. Statistics used for the data analysis included mean and standard deviation, and t-test at 0.05 level of significance.

Findings and Results

Following the earlier stated hypothesis one that there is no significant difference between teachers 'understanding of cognitive concepts maps and students performance in problem solving in mathematics.

Table 1: Teachers 'understanding of cognitive concepts maps and students performance in problem solving

Variables/Status	Count	Mean	Deviati-on	df	t-cal	t-val	Significance
Mathematics Teachers	10	87.0	2.22	9	37.387	1.925	P<0.05*
SS 2 Students	58	57.9	2.56	57			
Total	68			66			

* Significant at 0.05

The result from the table 1 above shows that there is a significant difference between teachers 'understanding of cognitive concepts maps and students performance in problem solving in mathematics (t-cal>t-val, df = 66; P<0.05). The implication of this result shows that the academic output of the students in the problem solving of the cognitive concepts was quite different from the level of understanding of their mathematics teachers, and this might accounted for the varying level of achievement on one hand, and their teaching pedagogy that influence students in the subject as a whole.

On the second hypothesis that there is no significant difference between teachers 'understanding of cognitive concepts maps and male student's performance in problem solving in mathematics

Table 2: Teachers 'understanding of cognitive concepts maps and student's performance in problem solving

Variables/Status	Count	Mean	Deviation	df	t-cal	t-val	Significance
Mathematics Teachers	10	87.0	2.22	9	26.924	2.021	P<0.05*
Male SS 2 Students	30	60.4	2.84	29			
Total	40			38			

* Significant at 0.05

The result from the table 2 above shows that there is a significant difference between teachers 'understanding of cognitive concepts maps and male students performance in problem solving in mathematics (t-cal>t-val, df= 38; P<0.05). The implication of this result shows that gender of students play a prominent role in the academic output of the students in the problem solving of the cognitive concepts as it was quite different from the level of understanding of their mathematics teachers. This demonstrated that even when male students are skewed towards mathematics there clear difference in their performance of problem solving when compared to the understanding of cognitive concepts maps by their mathematics teachers. There is a need for proactive pedagogical approach of disseminating knowledge of the subject in order to enhance its learning.

On the third hypothesis that there is no significant difference between teachers 'understanding of cognitive concepts maps and female student's performance in problem solving in mathematics.

Table 3: Teachers 'understanding of cognitive concepts maps and student's performance in problem solving

Variables/Status	Count	Mean	Deviation	df	t-cal	t-val	Significance
Mathematics Teachers	10	87.0	2.22	9	6.261	2.021	P<0.05*
Female SS 2 Students	28	54.6	2.38	27			
Total	38			36			

* Significant at 0.05

The result from the table 3 above shows that there is a significant difference between teachers 'understanding of cognitive concepts maps and female students performance in problem solving in mathematics (t-cal>t-val, df= 36; $P<0.05$). The implication of this result shows that female students' performance was quite different from the level of understanding of their mathematics teachers. This demonstrated why female students tend to develop phobia for the subject when mathematics teachers that supposed to vibrate at parallel level of knowledge dissemination are acting in contrary, hence the multiplier dismal performance in science education for which mathematics is a tool of implementation.

Discussions

The study showed that teachers of mathematics had basic understanding of cognitive concepts though at variance to students' performance. It is one thing to have better understanding of concept but another angle is how such people disseminate the knowledge to the understanding of students. The poor performance of students in mathematics had been traced on many roots of which most important is the lackadaisical approach of the teachers. Similarly, teachers play a very important role in the mathematics class because of the nature of the subject as perceived difficult by the students, hence the need for close relationship of teachers' understanding and students' learning to enhance performance. This is evident by Chako (2005) in her study of the learning outcome in secondary school as related to teachers-students interaction, where she found that teachers' attributes contributed highest to variance of achievement gained by students. At this point one may wonder to examine the mathematics teachers' quality along three knowledge bases namely content, pedagogic and pedagogic-content.

Since teachers' understanding of cognitive concepts has been more pronounced in the general performance of students, the effect of genders on academics performance goes beyond the activities within the classroom as similar output cannot be overruled. This, however, signal to all and sundry that meaningful academic performance of students might not be in sight if those entrusted to teach mathematics do not bring closely their understanding of a concept to the students being taught. It could be argued in some quarters that content areas of the teachers at the training level is not the same as the syllabus entrusted to the to execute, yet this does not mean that great disparity of knowledge acquaintance should inhibit subsequent knowledge needed by the end users(i.e students).

Teaching in ways that support learners to become mathematically proficient is very challenging for many teachers. So, professional supports in relation to specific teaching practices, for example in generating and sustaining learners' interaction may be necessary to improve teaching effectiveness, as well as improve learners' achievement and their level of mathematical reasoning and proficiency. Such support could be as simple as dropping a hint on practices that could be adopted to sustain learner's interaction such as allowing use of language of choice.

Conclusion and Implication

Study has shown that all has not well with the expectation of mathematics classroom going by the end-results. It is pertinent to note that where teachers had better understanding of the cognitive concepts it was not translated to the desirable output. This situation has endangered the stimulation for the science education development for which appropriate language is Mathematics. Furthermore, every mathematics teachers should understand these cognitive concepts and be able to extend their horizon for better understanding of the students. In a situation where concept is being defined with its own terminology does not give a clear indicators of knowledge assimilation to the students, rather it constitute knowledge inhibition. Science education might not move beyond the present one if changes in the knowledge dissemination in mathematics from teachers to the students are not improved, and without such an improvement the situation is better imagined worst than the agrarian society. When one has not experienced a better condition as occasion by development in science education one might not agitate for any improvement or change as already provided by knowledge in mathematics to launch every developed nation into where everyone desires to stay. Hence, the need to catch these students at early stage to show more commitment to the learning of mathematics via teachers' demystification of acquired knowledge in mathematics.

Recommendations

As much as study is concerned it has demonstrated that much ground need to be covered to ensure students' performance in mathematics is improved. This informs all the stakeholders that not everything must be left at threshold of the teachers whom these students spend small considerable number of period with in a day, while the highest number is spent at home. In as much as for every brilliant student in a class brings glory to the parent at first instance so also the dull ones bring the shame to the teacher; then a concerted effort must be made between school and home to correlate what student has been taught, gained and further expatiate of these knowledge to complement the school ones. Society should not only look at the teachers to perform magic on the rotten students when they ought to have come to their rescue. This is to say that life exist when an egg is broken from inside, but the same life is terminated when an egg is broken from outside. Mathematics teachers should wake-up and brainstorm among themselves on the need to fasts track better way of handling the subject in a student' centrednes manner and this could be through seminar attendance to update their knowledge base.

Suggestion for further studies

Teachers' gender should be examined in line with the above-mentioned attribute in mathematics and other secondary school subjects. Apart from this a cross-sectional study into other two domains of knowledge could be explored to understand students' strength and weakness with the hope of providing a durable solution. More of these studies are essential for the secondary school subjects that are science education developing ones otherwise the laudable goal of science education and development would become a dream in futility.

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