UNIVERSITY OF ILORIN

THE ONE HUNDRED AND SIXTY-EIGHTH (168th) INAUGURAL LECTURE

"LANGUAGE AND PROBLEM SOLVING: THE MATHEMATICS EDUCATION LINK"

By

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Gentlemen of the Print and Electronic Media,
Distinguished Guests,
Great Unilorites!
Ladies and Gentlemen.

Preamble

Mr Vice Chancellor Sir, permit me to appreciate the Almighty Allah for the rare opportunity and uncommon privilege He bestowed on me to be here today. To HIM be the Glory and Adoration.

In the name of Allah; the most Gracious, the most Merciful;
All Praises and thanks be to Allah the Lord of the Worlds;
The beneficent and the Merciful
The only Owner of the Day of Judgement;
You (Alone) we worship, and You (Alone) we ask for help;
Guide us on to the right path;
The path of those on whom You have bestowed Your Grace, not the path of those who have earned Your Anger, nor of those who go astray (Qur'an 1: 1 - 7).

Mr Vice Chancellor Sir, I feel honoured and privileged for the opportunity given to me to inform colleagues, the University community, and the general public of my academic contributions, especially my researches and future plans, through an inaugural lecture, an occasion very significant in an academic's career at the University. As an Inaugural Lecturer, I give thanks and adoration to the Almighty Allah for making it possible for me to present the 168th inaugural lecture titled ''Language and Problem Solving: The Mathematics Education Link'' I must express my sincere gratitude to the authority of the University of Ilorin under the able leadership of the Former Vice Chancellor of this great University, Prof. Is-haq Olanrewaju Oloyede (OFR) for appointing me a Professor of Mathematics Education in 2012.

Introduction

Mr Vice Chancellor Sir, in educational research, topics are sometimes generated from occurring challenges in the educational system or from personal experiences of the researcher. The basis for my researches in the area of Language and Problem Solving in Mathematics Education is related to two personal experiences. The first incident happened when I was in the primary school; I was taken to a Qur'anic lesson centre traditionally called *Ile-kewu* where a Mallam was engaged to teach us how to recite the Holy Qur'an. The Mallam was a Hausa man. The practice was that as he read the verses of the Qur'an, we were expected to read after him. As a newcomer, on the first day of my arrival at the *Ile-kewu,* the Mallam received me warmly. He later turned over to me and started to recite the Qur'an which I believed he was expecting me to repeat after him. This I did. He later said in Hausa, "*In Kara, ko ko yaisa?*" I also repeated the statement thinking it was the continuation of the verses of the Qur'an being recited. Suddenly, I discovered that other children present at the *lle-kewu* burst into laughter. I wondered what could have been the cause of their laughter. One of them who spoke Yoruba and Hausa fluently explained to me that the Mallam was asking in Hausa whether he should take me through more verses or stop. This scenario affirms that language barrier can be a hindrance to effective teaching and meaningful learning.

The second incident was related to poor performance in Mathematics of my grandnephew while in primary 2. One day, I stumbled on his Mathematics notebook, which I took time to go through. I saw red ink marks on every page of the notebook indicating low performance. I became interested in finding out why he could not solve correctly problems involving addition of two digit numbers. What first came to my mind was the issue of whether the boy understood the meaning of the addition operation symbol (+), and its pronunciation. I later asked him for the correct pronunciation of the symbol for the operation of addition (+) as well as its meaning. He replied by saying “Norse”. I was baffled, I asked the boy again. “Is this how it is pronounced by your teacher?” He said “yes”. I asked another question, “What is the meaning of the addition symbol?’’ The boy said “cross’’. I now discovered that the boy did not understand the meaning and correct pronunciation of the addition symbol and other technical terms in the given problems. These symbols and technical terms are part of the meta language which most teachers of Mathematics assume all learners understand and thus should be used to solve problems involving basic operations correctly.

These two incidents informed my research interest in pre-teaching of meanings of technical terms, such as symbols, vocabularies, formula, defined and undefined concepts in Mathematics. The stock of technical terms and their meanings in Mathematics is referred to as **Mathematics Language.**

Meaning and Nature of Mathematics

The word “Mathematics” can be inflected and used as a verb and also as a noun. It is a verb when one is involved in carrying out a process to solve a problem (i.e. Mathematising), which will result into a product. The product is Mathematics, which is a noun. Mathematics is made up of undefined terms, principles of logic, hypotheses and conclusions that follow from the hypotheses

(Fajemidagba & Adegoke, 2008). Mathematics can therefore be conceptualised as all propositions in the form of if p then q.

The Encarta English Dictionary (1999) defined Mathematics as the study of the relationship among numbers, shapes and quantities, either as abstract concepts (pure mathematics), or as applied to other disciplines, such as physics and engineering (applied mathematics):. It uses signs, symbols, and proofs and includes arithmetic, algebra, calculus, geometry and trigonometry. In the same vein, Schwab (1964) conceptualised Mathematics as a highly structured discipline which is "conceptual and syntactic". The conceptual structure deals with the products of Mathematics, such as theorems; defined concepts (e.g., triangle, cone, addition, rectangle, polygon, etc); undefined concepts (point, line, plane); and postulates. The syntactic structure consists of the processes used in solving problems such as induction, deduction and idealisation (Farell & Farmer, 1980). To successfully solve a problem, the problem solver is required to have adequate understanding of the two structures. The world of Mathematics is full of ideas and the ideas are generated through some processes. Where there are processes, there must be products. Every set of processes will yield a distinct set of products. The same trend is in the physical world of Mathematics.

Figure 1 shows the Idea model and the physical model of Mathematical entities. The model is a synthesis of the process/product views of Mathematics in relation to the physical world and the idea world. Mathematical concepts are inventions, constructs and creation of the idea world (Farell & Farmer, 1980). The motivations for mathematical development often begin in the physical world and are utilised constantly to solve real-world problems. Concepts and assumptions are inventions of the human mind. They are not the thoughtless gibberish (nonsense) which might be assembled by a robot. The rationale for such inventions sometimes takes the form of a motivating force, a need in the physical world, or desire for a simpler way of handling a chore (routine task); roots in history, in common usage or in the etymology of a word.

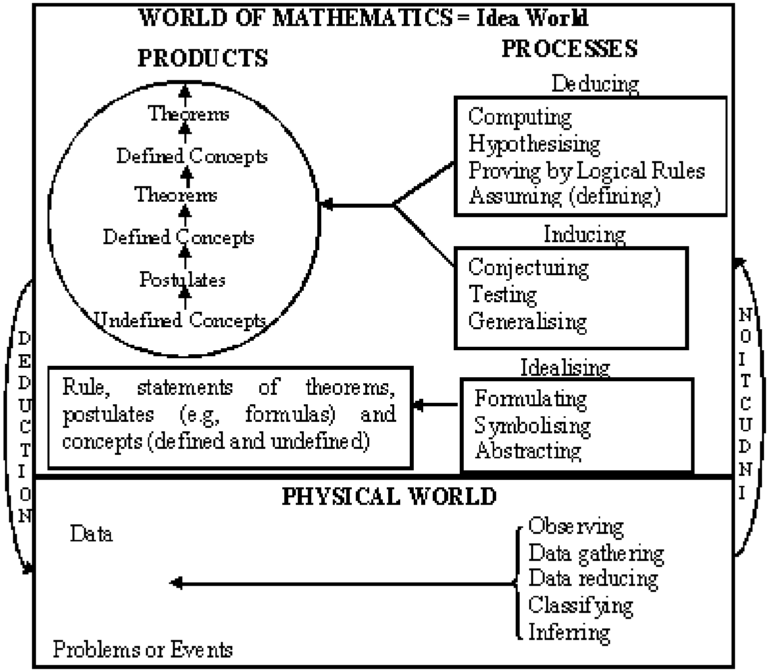


Figure 1: Schematic Thought Model of the Nature of Mathematics
Source: Farell, M. A. & Farmer, W. (1980)

Processes in Mathematics lead to generalisations deduced from certain patterns, which is a product. A generalisation could be obtained from a mathematical product. Let us consider a generalisation from a powerful mathematical product of Pascal’s Triangle:

Example

$$
\begin{array}{ccccccccccccc}
 & & & & & & 1 & & & & & & \\
 & & & & & 1 & & 1 & & & & & \\
 & & & & 1 & & 2 & & 1 & & & & \\
 & & & 1 & & 3 & & 3 & & 1 & & & \\
 & & 1 & & 4 & & 6 & & 4 & & 1 & & \\
 & 1 & & 5 & & 10 & & 10 & & 5 & & 1 & \\
1 & & 6 & & 15 & & 20 & & 15 & & 6 & & 1
\end{array}
$$

Ask students to add the numbers in each row of the Pascal’s triangle as far as they like as shown below:

$$
\begin{array}{rl}
1 & = 1 = 2^0 \\
1 + 1 & = 2 = 2^1 \\
1 + 2 + 1 & = 4 = 2^2 \\
1 + 3 + 3 + 1 & = 8 = 2^3 \\
1 + 4 + 6 + 4 + 1 & = 16 = 2^4 \\
1 + 5 + 10 + 10 + 5 + 1 & = 32 = 2^5
\end{array}
$$

The generalisation is that the sum of the numbers in each row of the Pascal’s triangle is equal to 2 raised to the power of the number of items in each row less than one or 2^{n-1} where n is the number of items on each row.

Mathematics consists of patterns of related ideas and patterns of thought. The development of simple convenient mathematical patterns is an important part of the evolution of Western culture. These patterns appear in nature; for instance, the blossoms of some flowers naturally arrange themselves in interlacing spiral curves.

Flower ***Pineapple*** ***Solar System***

Source: googlesearch.com

The arrangement of some seeds and fruits like pineapple, the arrangement of leaves on trees, the solar system, and galaxies, all depict patterns of arrangement (Ukeje, 1989). There are also patterns which are arithmetical. For instance, the sum of odd numbers is the same as the multiples or square of counting numbers.

Example 2

$$1 = 1^2$$

$$1 + 3 = 2^2$$

$$1 + 3 + 5 = 3^2$$

$$1 + 3 + 5 + 7 = 4^2$$

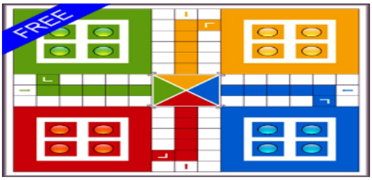
$$1 + 3 + 5 + 7 + 9 = 5^2$$

The generalisation from this is that the sum of the odd numbers is equal to the square of the number of items in each row = n^2 (power of counting numbers).

With little imagination, one can predict the sum of 1 + 3 + 5 + 7 + 9, and that of any number of a successive consecutive odd numbers without adding. Since Mathematics results from the discovery, the formulation, the systematic development, and the application of patterns in inductive and deductive thinking, part of the establishment of Mathematics culture lies in the observation and recognition of patterns in nature, in art and architecture (Ukeje, 1989).

Mr Vice Chancellor Sir, there is also a relationship between games and Mathematical patterns. Most games are dependent on mathematical patterns. They have geometrical plan in their mode of play and arithmetical plan in their mode of scoring. In addition, all games have an abstract Mathematical pattern embodied in their rules, which govern the manner in which the games are played. These rules correspond to assumptions in Mathematics. For instance, games like Chess, Ludo, and traditional African game (i.e Ayo Olopon) have been studied mathematically, while statistics and probability theories originated from the study of gambling games.

Chess



Ludo

Ayo Olopon

Source: googlesearch.com

Mathematics has met cultural demands in the past and therefore, the future development of our culture is largely dependent on the establishment of mathematics culture. Mathematics culture means the ability, readiness and willingness to always think and act logically to use implications and logical deductions in our decision making process; to be free from prejudices and superstition; to behave and act in accordance with the laws of cause and effect; in fact to be scientific in our behaviour and mathematical in our thinking. It is essential for everyone to develop mathematics culture. Hogben (1940) referred to Mathematics as the mirror of civilisation. Humans developed from mere talking animal to a calculating being. Hence, modern man lives in a welter of figures; days of the week; months of the year; railway time-tables; taxes; speed limits; unemployment aggregates; cups of *garri*; rainfall records; bank rates; death rates; birth rates; interest rates; tyre pressures; distances and so forth. Concepts like ratio and limits acceleration, which are precision equipment, pervade our daily existence. These are cultural inheritance of the modern human and language is one of these major elements of cultural heritage.

Usefulness of Mathematics

Fajemidagba, Salman and Ayinla (2012) presented Mathematics as a tool for the development of any science-based discipline such as technology, astronomy, graphics, industry and analytical reasoning in daily living in a modern society. Salman (2005) identified the usefulness of Mathematics in tailoring, carpentry, bricklaying, town planning, driving, photography, technology, graphics, industry, astronomy, surveying, buying and selling; indicating its requirement in virtually all fields of study and human endeavour.

Tailoring

Carpentry

Bricklaying

Commerce/Banking

Buying and Selling at the local Market

Source: googlesearch.com

The scientists use Mathematics to design, experiment and analyse data. Mathematical formulas are used to express precise findings and make predictions based on findings. It helps industries to design, develop and test manufacturing processes and products. It is necessary in designing bridges, building dams, highways, and architectural and engineering projects. It is also an essential requirement for national development. Consequent upon its functional roles, it is made a core subject at the primary and secondary school levels in Nigeria. Thus, Mathematics is an indispensable tool for human survival, irrespective of culture, sex, race, discipline and religious affiliations. Human beings apply its knowledge to carry out daily activities, particularly in record keeping, commerce, measurement (e.g. distance, time) and music.

Language of Mathematics

Language in general is defined as the human use of spoken or written words as a communication system or a system of communication with its own set of conventions or special words. It is also defined as the use of signs, gestures (use of body movement) or inarticulate sounds to communicate something (*Encarta World English Dictionary*, 1999).

Mathematics as a discipline has its own specialised language. The language referred to in this context pertains to mathematical terms, symbols, signs, notations and formulas that are usually used in Mathematics sentences, routine problems, definitions and theorems (Salman, 2003). These terms are also referred to as “mathematical vocabularies”. For meaningful comprehension of concepts in Mathematics, a learner must adequately grasp these technical terms to correctly translate Mathematics sentences into their mathematical equivalence (equations). Such terms are found in Mathematics textbooks in three categories. One category is words with ordinary and mathematical meanings (e.g., angle, point, circle, and function). The second category is words whose meanings in common usage are the same in Mathematics context (e.g., cost, travel, average, height, weight, measure and volume). The third category are symbols and words meant to communicate mathematical ideas (e.g. less than, greater than, cosine, sine, tangent, gradient, and so on). The language of Mathematics differs from that of everyday life because it is essentially a rationally planned language. For instance, the language of size has no place for sentiments either of individuals or nations.

Table 1
Counting Numbers in Selected Languages

	English	Hausa	Igbo	Yoruba	French
0	Zero	Sifiri	Oroghoro	Oodo	Zero
1	One	ɗaya	Out	ení	Un
2	Two	Biyu	Abụọ	Eji	Deux
3	Three	Uku	Ato	Eeta	Trios
4	Four	huɗu	Ano	Erin	Quatre
5	Five	Biyar	Ise	Arun un	Cinq
6	Six	Shida	Isii	Efa	Six
7	Seven	Bakwai	Asaa	eeje	Sept
8	Eight	Takwas	Asato	Eejo	Huit
9	Nine	Tara	Iteghete	Eesan	Neuf
10	Ten	Goma	Iri	Eewa	Dix

The Arabic symbols 1, 2, 3, are universal with the use of English as global language today. The pronunciation varies across cultures and countries. Symbols are used to clarify ideas. Thus, it is the mathematical ideas which are characteristics of mathematics and not the symbols which express them. Hence, the establishment of Mathematics culture is rooted in the development of mathematical ideas which could be done in any language.

The examples of mathematical terms and their symbolic representations are in Table 2.

Table 2
Language of Mathematics

Mathematical terms	Mathematical Symbols
Addition	+
Subtraction	-
Multiplication	$\times$
Division	$\div$
Equal to	=
Not equal to	$\neq$
Approximately equal to	$\cong$
Less than	<
Less than or equal to	$\leq$
Greater than or equal to	$\geq$
Pi	π
Percentage	%
Point	.
Plus or minus	$\pm$
Infinity	∞
Square root	$\sqrt{\ }$
Union	$\cup$
Intersection	$\cap$
Subset	$\subset$

There are also sets of words that are different in spelling and in pronunciation but mean the same in mathematical interpretation with their equivalent symbols. Examples of such words are in Table 3.

Table 3
Symbols with more than one term or one word description

Symbols	Terms
+	Addition Plus And More than Sum of Combine Increased by
-	Minus Less Difference Subtraction Decrease by How many more How much greater Change Space between
X	Multiplied by Times Of Product of each Dot
÷	Divided by Out of Share Quotient of

$=$	Is equal to Was equal to total will be	
$<$	Is less than	
$>$	Is greater than Is more than	
$\leq$	Is less than or equal to Is at most Is no more than	
$\geq$	Is greater than or equal to Is at least Is no less than	
$\frac{a}{b}$	a out of b a divided by b (a ÷ b) a out of every b a for every b What percentage	

Source: Tapson (1999)

Problem Solving in Mathematics Education

Krulik and Rudnick (1982) described problem-solving as a means or an art by which an individual uses previously acquired knowledge, skills and understanding to satisfy the demand of an unfamiliar situation. Also, Lee (1982) defined it as an independent activity in which each problem solver attempts to mobilise whatever resources he or she thinks are most convenient and effective in carrying out the problem-solving activity. In other words, there are no set down methods to problem solving but it demands the ability to understand, give appropriate translation and think of different strategies that could help in arriving at the correct and appropriate solution to a given problem. In the same vein, Lester (1980) posited that mathematical problem solving is a set of actions taken to perform a task. Also, Polya (1957) described mathematical problem solving as an act meant to find a way out of a difficulty in order to attain a desired end. Branca (1980) referred to mathematical problem solving as a goal; a process; a basic skill; and a necessary minimum requirement for life.

One of the goals of teaching secondary school Mathematics is to develop in children the ability to recognise problems and to solve them with related mathematical knowledge (NPE, 2013). The National Council of Teachers of Mathematics (NTCM, 1980) recommended that problem solving be the focus of Mathematics teaching because it encompasses skills and functions, which are important parts of everyday life.

The ultimate goal of any problem-solving programme is to improve students' performance at solving problems correctly. The specific goals of problem-solving in Mathematics are to:

i. improve pupils' willingness to try problems and their perseverance when solving problems;
ii. improve pupils self-concepts with respect to the abilities to solve problems;
iii. make pupils' aware of the problem-solving strategies;
iv. make pupils aware of the value of approaching problems in a systematic manner;

v. make pupils aware that many problems can be solved in more than one way;
vi. improve pupils' abilities to select appropriate solution strategies;
vii. improve pupils' abilities to implement solution strategies accurately; and
viii. improve pupils' abilities to get more correct answers to problems (Salman, Ayinla, Adeniyi, Ogundele & Ameen, 2012).

Types of Problem Solving in Mathematics Education

Mathematics teachers use the words, question, exercise, and problem interchangeably in Mathematics lessons due to teachers' inability to differentiate among the three words. These three concepts are different. As an illustration, what is 3×47? In this context, the problem is a question which is given to an elementary school pupil who is studying the basic multiplication facts; one is providing a drill and practice for the pupil. In other words, the question becomes an exercise which involves practice. But if the task is given to a pupil who has never learnt about the multiplication table of three, but has learnt about that of two, in this context, the simple multiplication becomes a problem because the child now has to think of applying his/ her knowledge of multiplication table of two to obtain the solution. Thus, a question requires recall, an exercise provides drill and practice, and a problem requires careful thought and synthesis of knowledge (Krulik & Rudnick, 1982). Fajemidagba (1986) posited that exercise solving requires routine application of previously learned facts and procedures to formulate a solution, while problem solving involves some creativity in analysing, synthesising and evaluating situations.

Another type of problem is word problems in Mathematics. Word problems are mathematical statements which need to be translated into algebraic equations with the use of symbols. Mathematical word problems are aspects of mathematical problem solving that can be categorised under process problem. Such problems require that the problem solver understands both the contextual and technical meanings of every word featuring in the problem to be able to meaningfully translate the word problem into equivalent algebraic expressions. Many studies have reported that students have difficulties with solving word problems in Mathematics (Clement, 1982; Fajemidagba 1986; Salman, 2004)

Language and Problem Solving: The Mathematics Education Link

Mr Vice-Chancellor Sir, the performance of students in Mathematics as a school subject as seen from the perennial failure in public examinations such as, the Senior School Certificate Examinations conducted by the West African Examinations' Council (WAEC) and National Examinations' Council (NECO) is worrisome. Researchers have identified causes of students' failure in Mathematics to include but not limited to: lack of frequent practice, inadequate grasp of its technical language, poor mathematical background of the students, influence of parents on child's career choice, incompetent handling of difficult Mathematics topics by teachers, poor pedagogical approach or strategies, non-involvement of learners in practical classroom activities and failure on the part of the teachers to relate Mathematics to real life activities (Salman, Mohammed, Ogunlade & Ayinla, 2012).

Researchers in Mathematics Education have also identified certain topics in Mathematics that are perceived difficult to teach by teachers and to learn by the students. Salman (2005) carried out a study on Teachers' identification of the difficulty levels of topics in the primary school Mathematics curriculum in Kwara State. The result of the study showed that certain Mathematics topics particularly word problems are found difficult to teach by teachers and to learn by the pupils. Such topics include descriptive geometry, everyday statistics, volume, capacity and area of angles. It was also revealed that out of the 241 teachers that responded to the questionnaire, teachers with NCE Certificate (73.4%) as basic qualification outnumbered other categories of teachers. Based on their subject specialisation, 31.12% studied Social Studies, 21.99% studied Integrated Science, and 3.69% studied other science combinations **while only 16.60% studied Mathematics**.

The implication of this finding is that the teaching of the subject is not being handled by qualified teachers. Hence, students dislike the subject and this leads to poor performance at this level and other higher levels of education since a poor foundation had been laid at the primary level. In addition, the dislike for certain topics by teachers would undoubtedly hinder the meaningful learning of such topics and similar topics that appear in the Mathematics curricula of secondary schools. In a similar study, Salman (2009) examined Nigerian primary school teachers' assessment of Active Learning Technique (ALT) in a workshop organised by the United Nations

Educational, Scientific and Cultural Organisation (UNESCO). The result of the analysed data showed that practical and descriptive geometry (solids) had the highest percentage (76.4%) of respondents followed by **word problems with 69.4%.** The implication of this finding is that the perception held by the primary school teachers that certain topics are difficult to teach, confirmed that inadequate knowledge of Mathematics is imparted to the pupils and this could be a major factor that accounts for low performance in the subject.

In a similar study, Ameen and Salman (2016) identified perceived difficult concepts in the new senior secondary school Mathematics curriculum by senior secondary school teachers and students using 100 Mathematics teachers and 200 senior secondary school students as sample for the study. The result of the study indicated high percentage of respondents finding the newly introduced topics/concepts difficult to teach by teachers and to learn by students. These include: Integration and Application (78.57%); Geometric Construction (77.55%); Coordinate Geometry (77.54%); Differentiation and Application (76.53%); Financial Mathematics (70.92%); Bearing (59.185); and **Word Problems (57. 63%)** among others. The word problems indicated as one of the aspects of secondary school Mathematics found difficult could be traced to the poor foundation at the primary school level.

Poor mastery of the technical terms and the syntax of word problems often lead students to committing errors when solving mathematical problems as noted by WAEC Chief Examiner's observation Report (2012).

Nov/Dec. 2012

Question 7

(b) In one month, a man spent ₦650 on newspapers and ₦240 on soap. The next month, he reduced his newspaper spending by 40%. If the ratio of the amount spent on soap in the second month to that of the first month is 5:3, what is the difference in the amount spent on both items in the two months?

Chief Examiner's Observation Report

The Chief Examiner reported that some candidates could not go beyond finding 40% of N650.

Question 13

(b) The fourth term of an Arithmetic Progression (A.P) is 1 less than twice the second term. If the sixth term is 7, find the first term.

Chief Examiners' Observation Report

Candidates' performance was reported to be poorer than what it was in part (a). The majority of the candidates could not interpret the word problem involved correctly and so could not obtain the correct linear equations.

Mr Vice-Chancellor Sir, it has been established that errors are usually committed in problem solving in Mathematics as a result of lack of the knowledge of the technical language and contextual meaning of mathematical concepts. Fajemidagba (1986) affirmed that students at any level of education do commit errors in the process of translating mathematical statements into algebraic equations. Salman (2004) explained the difference between error and mistake, which are usually interchangeably used because they stand in for an incorrect idea (i.e. misguided information). A “mistake” has the characteristics of being corrected when challenged while “error” does not possess such characteristics. For example, if a secondary school student is to solve: ‘A piece of cloth was measured as 6.10m. If the actual length of the cloth is 6.35m, find the percentage error correct to 2 decimal places’, and suppose the correct answer to the problem is 3.94% but the student writes the answer as 3.94 without putting the percentage symbol, this is referred to as a mistake, because the student shows understanding of the problem but probably forgets to put the symbol (i.e., %). Tapson (1999) defined ‘error’ in Mathematics context as the difference between the value of an approximation and the true value. It was further explained that ‘error’ may or may not have a plus (+) or (-) sign attached to indicate whether is too big or too small.

Mr Vice-Chancellor Sir, in the course of finding out the challenges of students with word problems, I have encouraged some of my postgraduate students to conduct researches on the effects of mathematical language and analysis of errors committed by secondary school students while solving word problems in Mathematics.

For example, Familola (2011) carried out a study on the effects of mathematical language as pre-instructional strategy on Junior Secondary Students’ performance in Mathematics. Specifically, the study determined the effects of mathematical language on JSS students’ performance in statistical graphs. Findings from the study showed that students exposed to the treatment of pre-teaching of mathematical language before the teaching of the actual topic performed better than their counterparts in the control group. Table 4 shows some of the terms pre-taught.

Table 4: Mathematical terms, Dictionary meanings and Mathematical meanings pre-taught

Mathematical Terms	Dictionary Meanings	Mathematical Meanings
Frequency	Number of times a sound or radio waves vibrates within a specified period of time	Rate at which something occurs in a given sample
Pictogram	A Picture representing a word or phrase	A picture representing statistics on a graph, chart, or computer system
Angle	A position or a Direction	Difference in direction between two lines or surface measured in degree
Table	A piece of furniture with a flat top and legs to stand	Set of facts or figures arranged in rows and columns
Deviation	Difference in behaviour or belief from which people consider to be norms.	Moving away from the figures
Range	A large area of open land for grazing or hunting	Complete group that is included between two points on a scale of measurement
Values	Quantity or worth of something	The amount represented by a symbol, letter or figure.
Scores	A goal in sports or a quarrel	A set of values
Data	Symbols operated on a computer	Statistical information used for analysis

Based on the findings of the study, it was recommended that teachers should always teach mathematical terminologies and symbols first before teaching the actual topic, while textbook writers should also have a section for definition of mathematical terms in their textbooks.

Also, Tiamiyu (2014) analysed the errors committed in solving word problems involving set theory in Mathematics by Senior Secondary School students. The study identified five (5) types of errors committed by students in solving word problems involving set theory. These errors include: structural, supposition, translation, operation and random errors. It was further affirmed that the errors were committed as a result of language problem.

Adigun (2016) examined the type of errors committed in solving fraction problems by SS II students in Oyo State. The findings of the study revealed that students committed seven, six and four types of errors in compound, algebraic and word problems involving fractions respectively; fact error of least common multiple (LCM) was committed 523 times; incorrect operations (117 times), incorrect procedures (349 times), missing steps (145 times), comprehension (428 times), transformation (427 times), procedure (427 times) and encoding errors (427 times). The study concluded that errors in solving fraction problems are common among secondary school students irrespective of gender, school location and subject combinations.

My Contributions to Mathematics Education on improving Students' Academic Performance in Word Problem-solving in Mathematics

Mr Vice-Chancellor Sir; the presentation has established the link between mathematics language and problem solving, specifically word problem solving in Mathematics. The difficulty students have with problem solving in Mathematics could be attributed to inadequate understanding of Mathematics language; thus culminating in errors. Attempt was therefore made to identify types of error usually committed by students and investigate the effects of some innovative instructional strategies that could enhance students' understanding and performance in word problems solving in particular and Mathematics as a subject in general. Also, in the course of my academic pursuit as a practising teacher and as a lecturer, I have been involved in several researches that focused on how to improve students' academic performance in Mathematics.

Salman (1989) investigated problem solving instructional strategies of concrete and formal operational Junior Secondary School students in Mathematics word problems using two instruments; the Longeot Test of Formal Operations and Mathematics Achievement Test and found that there was a relationship between students' cognitive level and problem solving ability. The students at the concrete level were better thinkers and problem solvers when there was concrete support that assisted their understanding of the given problems while the formal thinkers could handle problems that involved abstractions.

Salman (2003) determined the effects of language on students' performance in word problem solving in Mathematics. The study involved 120 male and female secondary school students that received a lesson prior to the teaching of mathematical terms and symbols that are subsumers of indices and logarithms while the second group composed of 64 males and females who received instruction through the lecture method. The investigator administered a self-constructed Mathematics Word Problem Test after instruction to the two groups. Results of the analysed data indicated that there was a statistically significant difference between the mean score ($\bar{x}$ = 35.33) of students exposed to operational meanings of selected Mathematics term and the mean score ($\bar{x}$ = 25.75) of those taught using the conventional method. There was also no statistically significant difference between the performance of male and female students exposed to technical meanings of mathematical terms. It was inferred that Mathematics can be effectively learned through prior teaching of technical meanings of subsumed terms and symbols.

Also, Odetola and Salman (2014) examined the effects of mathematical language on errors committed by senior school (SS) students in bearing problems in Mathematics. The study adopted the quasi-experimental method using 120 SS II students as sample for the study. A researcher-designed Mathematics Performance Test (MPT) was used as the instrument for data collection. The experimental group received treatment on mathematical language while the control group did not receive any treatment on mathematical language. The results of the study showed that the treatment group committed fewer errors due to their exposure to the treatment on mathematical language. The study concluded that students commit errors in word problems due to inadequate understanding of the mathematical language used in bearing problems, and the inability to carry out instructions appropriately and to translate expressions in bearing questions to diagrams correctly.

Ameen and Salman (2015) examined students' mathematical language proficiency as predictor of their performance in mathematical bearing word problems. A purposive sampling technique based on gender and school type was used to select 105 senior secondary school II students in Ilorin metropolis of Kwara State, Nigeria. The experimental group was taught a list of mathematical language instructions in bearing prior to the teaching of bearing as a topic in mathematics while the control group was taught using the lecture method. Four essay items on bearing word problems drawn from the senior school certificate examination questions in mathematics were used as instruments for data collection. The finding indicated that students in the experimental group performed significantly better than those in the control group; gender has no significant influence on students' performance; while school type had a significant influence on students' performance in word problems involving bearing. The researchers recommended that mathematical language instructions in bearing should be taught before engaging students in solving word problems to enhance adequate mastery of the topic.

Having affirmed that students commit errors when solving mathematical word problems due to language deficiency, Salman (2002) investigated the type of errors committed in word problems by concrete and formal operational junior secondary school students in Mathematics. Purposive and random sampling techniques were used to select five secondary schools from five local government areas of Kwara State and 100 junior secondary school III students respectively. The findings of the study revealed that students identified as formal operational thinkers committed less errors than the concrete operational students. It was therefore recommended that word problem solving be given adequate attention in Mathematics lessons.

In another study, Salman (2004) analysed the errors committed in word problem involving simultaneous linear equations by junior secondary school students in Ibadan, Nigeria. One hundred and fifty students were used for the study. The data collected was analysed using both descriptive and inferential statistics. The frequency counts of the type of errors committed as well as the rate of occurrences of the errors by the respondents were recorded. Chi-square statistics was used to determine whether significant difference existed in number of times the errors are committed by male and female students. Errors identified include: supposition, translation, operation, elimination, substitution and unit. It was also revealed that gender has no significant influence on the rate at which each error identified was committed. The researcher then recommended that Mathematics teachers should assist students on how to identify the unknown in the word expression through exposure to series of examples and the problem solving strategies.

In the quest for finding suitable teaching strategies to address students' poor performance in Mathematics word problem solving, Salman (2000) investigated the effectiveness of Ausubelian pre-instructional strategy in enhancing meaningful learning and retention of learned materials perceived difficult to comprehend by students in Mathematics. The purpose of the study was to interpret some considered mathematical vocabularies and grammatical expressions considered difficult for the students before the teaching and learning process for better understanding by the learners. The researcher adopted an experimental technique which involved two groups consisting of 120 Senior Secondary (SSI) students. The experimental group was exposed to a prose (Advance Organizer) passage while the control group was not exposed to prose passage. The data collected were analysed using t-test statistics at 0.05 significant levels. The findings revealed that students taught through prior exposure to a prose passage performed significantly better in solving mathematical problems than their counterparts in the control group.

Also, Fajemidagba, Salman and Ayinla (2012) examined the effect of teachers' instructional strategy pattern on senior school students' performance in Mathematics word problem in Ondo, Nigeria. A total number of 125 senior secondary II students were purposively sampled from two schools in Ondo town of Ondo State, Nigeria. The researchers adopted a quasi-experimental design involving a 2 x 3 factorial matrix. The findings of the study showed that the experimental group exposed to instructional strategy pattern performed significantly better in Mathematics word problem solving involving simultaneous equations than their counterparts in the control group. The researchers therefore, recommended the use of instructional strategy pattern for the teaching and learning of word problems solving in Mathematics.

In another study, Salman, Ayinla, Adeniyi, Ogundele and Ameen (2012) examined the effects of problem-solving instructional strategy on senior secondary school students' attitude towards Mathematics in Ondo, Nigeria. Purposive sampling technique was employed to select 173 SS II students for the study. A quasi-experimental, non-randomised, non-equivalent, pretest, posttest control group involving a 2 x 3 factorial design was employed for the study. Findings from the study revealed that the experimental group showed positive attitude towards problem solving and significantly performed better than their control group counterparts in Mathematics word problem solving. The researchers therefore, encourage mathematics teachers to shift from the teacher-centred method of teaching word problem in mathematics to problem solving instructional strategies for students' better academic performance in mathematics.

Also, Salman, Yahaya, Yusuf, Ahmed and Ayinla (2012) investigated the effects of the use of behavioural objectives on senior secondary students' academic performance in Mathematics in Omu-Aran, Kwara State. Purposive sampling technique was employed to select 179 students for the study. A quasi-experimental design was employed. The experimental group students were given the behavioural objectives of the lesson prior to the lesson in order for them to be aware of the expected learning outcomes after the lesson while the control group students did not have access to the teacher's set behavioural objectives of the lesson. Findings from the study indicated that students who were exposed to teacher's set behavioural objectives of the lesson prior to the lesson performed significantly better than their counterparts who were not privileged with access to the behavioural objectives of the lesson. The researchers recommended that Mathematics teachers should give the set behavioural objectives to their students prior to Mathematics lessons in order for the students to be aware of their expected learning outcomes.

Salman and Ameen (2014) studied the comparative effects of two problem-solving models on senior secondary school students' performance in Mathematics word problems. The study adopted the pretest, posttest, quasi experimental design. A total of 180 senior secondary II were purposively selected from six secondary schools in Ilorin metropolis. The findings of the study showed that there was a significant difference between the performance of the experimental and the control groups in favour of the experimental group. Gender had no significant influence on the performance of students exposed to the instructional modes while subject combination of the students had significant effect on the performance of students exposed to Polya's problem-solving model with the science students having the highest mean gain score followed by the commercial students while the arts students had the least mean gain scores. Based on the findings, it was recommended that Polya problem-solving model be used by the subject teachers to teach Mathematics word problems involving bearing in Nigerian secondary school and that the teachers should take time to teach Mathematics language in bearing before proceeding to the actual concept because it enhances better transformation of the word expression into mathematical expression.

Adeniyi and Salman (2015) examined the use of Personalised System of Instruction (PSI) on senior secondary school achievement in Mathematics in Kwara South senatorial district. The researcher employed quasi-experimental design of the pretest, posttest, non-equivalent and non-randomised control group. The sample was made up of 170 male and 150 female students. The result of the study revealed a significant positive effect of PSI on the achievement of senior school students in Mathematics. The study recommended that professional bodies and The Federal Ministry of Education should train teachers on how to effectively use PSI in the teaching of Mathematics for students' better accomplishment in the subject.

My other Contributions

Mr Vice-Chancellor Sir, my contribution to Mathematics education has spanned over 35 years. I have taught Mathematics at different levels of education. I taught Mathematics for 17 years at the secondary school level, 2 years part-time teaching at College of Education and have taught some Mathematics and Mathematics methodology courses at the University level. I have served as a resource person for UNESCO organized workshops on Active Learning Teaching for primary school teachers. The workshops are for training teachers on innovative techniques for teaching difficult concepts in Mathematics. I have also served as a resource person in Teacher Professional Development Programmes organised by the Kwara State Government in collaboration with the World Bank. Specifically, I was involved in the re-training of secondary school Mathematics teachers across the Local Governments in Kwara State.

I was one of the contributors in a Mathematics book project for Junior Secondary Schools sponsored by the Kwara State Government. I have also taken an active part in module preparation just as I have been a facilitator for many educational consultancy outfits for training of secondary school Mathematics teachers.

In the past 18 years that I have joined the University, I have been able to supervise to completion over 300 undergraduate student projects, over 34 Masters Dissertations and 7 Doctoral Theses in Mathematics Education. My collaboration with these students in investigative studies has made a positive impact on my work as a Mathematics educator. I have served as an external examiner for the appointment and promotion of high level academics in Mathematics Education at Colleges of Education and Universities. I have served as the Vice Chairman and Chairman of the Mathematical Association of Nigeria, Kwara State Branch. I have also served as National Financial Secretary of the Mathematical Association of Nigeria and I have been specifically active in preparing pupils and students for the annual Olympiad competitions in Mathematics.

Conclusion

Mr Vice-Chancellor, Sir, Mathematics is one of the core subjects at primary and secondary school levels of education due to its importance and usefulness in everyday activities. From the results of the researches I have carried out, I have deduced the fact that the mode of instruction, especially at both primary and secondary levels of education remains overwhelmingly teacher-centered, with greater emphasis on the use of the lecture mode of instruction and the use of textbooks rather than engaging students in critical thinking across subject areas and in applying the knowledge acquired to solving real life problems.

The role of teachers at all levels of education is emphasised in the National Policy on Education that no nation or educational system can rise above the quality of its teachers. This declaration underscores the need for teachers' effectiveness in the teaching and learning process. It is the teacher's competence, ability, resourcefulness, and ingenuity through effective utilisation of appropriate language, methodology and available instructional materials that could bring out the best from the learners in terms of academic achievement. Also, consistent engagement of students in critical thinking, reasoning and brainstorming would lead them to better and more detailed understanding of Mathematics as well as increase their abilities to demonstrate complex problem solving, reasoning and communication skills.

It is therefore imperative for teachers of Mathematics to adopt the use of effective instructional strategies that would enhance and encourage the students to meaningfully acquire the knowledge of Mathematics and problem solving skills, so that they can adequately participate in science and technology programmes at institutions of higher learning. This is necessary because without Mathematics, there is no science; without science, there is no modern technology; and without modern technology, there is no modern society.

Recommendations

Mr Vice-Chancellor, Sir, arising from my presentation, I hereby recommend the following:

A. Government

i. The teaching of Mathematics at all levels of education should be handled by professional Mathematics teachers only.

ii. The Ministries of Education should organise regular training workshops and seminars for Mathematics teachers at primary and secondary school levels. This will afford them the opportunity to update their knowledge and also give them awareness on innovative methods of teaching the subject.

iii. There is the need for the Ministries of Education to get periodic feedbacks from researches conducted on challenges facing the teaching and learning of mathematics from faculties of education in Nigerian universities in order to assist in the implementation of the recommendations made from such studies.

B. Students

i) Students should not give room for negative influence by their peers. Many students dislike Mathematics out of the common saying by their peers that “Mathematics is difficult” without any reasonable justification for the claim

ii) Students should imbibe the culture of readiness and willingness to learn. That is, they should develop interest in learning the subject because it is a basic requirement for further studies and career choice.

iii) Students should engage in regular practice, participate in group study and competitions at local, national and international levels. This will provide opportunities for knowledge sharing and social interaction.

C. Teachers

i) Teachers should develop the ability to relate the content/knowledge to real life situations by engaging students in practical activities relevant to the content.

ii) Mathematics teachers should pre-teach technical terms that may constitute barriers to students' understanding of topics in Mathematics.
iii) Teachers should create a friendly atmosphere of success for the learners and also involve them in application of problem-solving models such as Polya and others.

D. Textbook Authors

i. A section should be dedicated to meanings of technical terms that could constitute barriers to problem solving in Mathematics.
ii. Authors of Mathematics textbooks should clearly suggest the patterns considered appropriate to teach each topic.

E. Professional Bodies

i. Professional associations such as the Mathematical Association of Nigeria should identify perceived difficult topics by primary and secondary school teachers and students and address such at conferences and workshops.
ii. The association should also work hand in hand with the National Mathematical Centre in Abuja to organise workshops and seminars for teachers on a regular basis.

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