Senior High School Students' Challenges in Solving Word Problems Involving Linear Equation in One Variable in Tamale Metropolis

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***Abstract:* - This paper examined the challenges students in Senior High School face in solving word problems in linear Equations involving one variable. The Action Research designed was used for the study. This is because the study was about helping students to develop interest so as to overcome their difficulties. Population of the study consisted of students of Tamale Business Senior High School. The purposive sampling technique was used in the study. In all, 2H class made up of seventy (70) students consisting of 44 Boys and 26 Girls were purposively selected for the study. Students in 2H class have more difficulties in mathematics than the other classes hence the choice of the class. Test and interview were the main instruments used for the study. Data was analyzed using descriptive statistics. The findings revealed that students had difficulties in solving non-routine word problems but could easily solved routine word problems. the researchers conclude that students had difficulties in solving non-routine word problems. Mathematics Teachers should involve students in series of non-routine word problems so as to enhance their approach in solving non-routine word problems relating to linear equations in one variable.**

***Keywords*: Routine, Non-routine, word problems, linear Equation in one variable and difficulties**

I. INTRODUCTION

Background to the study

Mathematics is described by the great scientist Galileo as the nucleus of the sciences, the mother of the sciences, the engineer and the heart and soul of all the sciences (Nokoe, 2007). Galileo, while commenting on the universe, concluded that the universe could not be read unless the mathematical language and the characters in which it was written were clearly understood (Nokoe, 2007). Similarly, Asiedu-Addo and Yidana (2000), described mathematics as a "means of sharpening the individual's mind, shaping the reasoning ability and developing the personality of the individual; hence its immense contribution to the general and basic education of the people of the world" (p.65). This implies that if children learn mathematics with understanding, they can become truly proficient in dealing with everyday problems and will be able to relate the mathematical ideas communicated to them.

Much is not known about how difficulties students face in solving word problems can be addressed. The intervention study was designed to examine the challenges students' face and how to develop their interest in dealing with word problems.

One of the challenges in the teaching and learning mathematics is solving word problems. Solving word problems is a difficult task for most students in Ghana. The analytical skills of most students are so weak that non-routine word problems that could be modeled into algebraic linear equations in order to get it solved are left unsolved. Results of the Trends in International Mathematics and Science study (TIMSS) where six African countries participated, showed that Ghana's JHS students' overall performance in mathematics was poor and significantly below the international average (Anamuah-Mensah, Mereku & Asabere-Ameyaw, 2004). The TIMSS report stressed that candidates were weak in using mathematical concepts and facts to solve word problems. The report further indicated that candidates were not able to translate statements into mathematical language, hence their inability to use mathematical algorithms to solve word problems. Mathematics has therefore remained one of the most difficult subjects at the basic and secondary school levels

Statement of the Problem

In Ghana, the Education Reform Review Committee (MOE, 2002), recommended a problem solving curriculum for pre-university education. It further recommended the application of appropriate mathematical problem solving strategies in the teaching and learning of mathematics. The recommendations of the review committee were implemented in 2007 and since then problem solving and by extension word problems had become part of the mathematics curriculum in Ghana. The syllabus requires the use of mathematics in solving everyday problems. Problem solving in the Ghanaian curriculum was in response to changes in the West Africa Senior Secondary Certificate Examination (WASSCE) for West African Countries. According to Heather (2005), recent reforms in mathematics education all over the world that attempt to put mathematics in the social domain of children has seen the inclusion of problem solving in the curricula of many

countries. The inclusion of problem solving in the curricula is to enable students to relate mathematics to real life situations, to become critical thinkers and to be able to solve their own problems (MOE, 2007).

Teaching at the basic school for six years and at the secondary level for seven years, the researchers' observed that many students consistently perform poorly in solving word problems. A particular example was a test conducted on four word problems to assess students' ability in word problem solving. Out of the 60 students who participated, only 6 representing 10% could answer all the questions correctly. In particular, 60% could answer two to three questions halfway, while 30% could not answer any question correctly. The results really showed that students have difficulties in solving word problems. One of the major difficulties students faced was how to develop linear equations from word problems hence the problem of the study.

Objectives of the Study

Following the purpose of research problem, the following objectives were formulated to guide the study:

1. To find out some of the difficulties students face in dealing with word problems involving linear equation
2. To develop students interest in dealing with word problems involving linear equations

Research Questions

The research questions that guided the study were:

1. What are some of the difficulties students at the Senior High School face in dealing with word problems involving linear equations?
2. In what ways can students' interest be developed in dealing with word problems in linear Equations?

Significance of the Study

Research has been carried out on the strategies and techniques used in teaching to give teachers a working knowledge of teaching word problems. There is however insufficient research on the difficulties experienced bystudents' in solving word problems and eventually how to develop their interest in dealing with word problems. This study therefore provides an interactive approach for solving word problems on linear equations in one variable.

Specifically, the study was designed to help SHS form two students to overcome their difficulties in solving word problems. Results of the study provide an alternative approach to encourage students to develop interest and confidence in solving word problems involving linear equations in a single variable. Being able to deal with word problems, will lead students to performance better in mathematics. The study provides mathematics teachers with an alternative method for teaching word problems involving linear equations in a single variable. Finally results of the study serves as a literature to the research community and as information to the curriculum developer to consider when designing the curriculum in future.

Word Problems

The term word problem in mathematics education is often used to refer to any mathematics exercise where significant background information on the problem is presented as a text rather than in mathematics notation. As word problems often involve a narrative of some sort, they are occasionally also referred to as story problems and may vary in the amount of language used (Pooran, 2010). According to Madis (2009), word problems can be examined at three levels. The levels are: the verbal formulation, the underlying mathematical relations, and the symbolic mathematical expression. Word problems can be further analyzed by examining their linguistic properties;

- (Level a), their logico-mathematical properties
- (Level b) or their symbolic representations
- (Level c). Linguistic properties can include such variables as the number of words in the problem or the mean sentence length.

The logico-mathematical properties can be classified in numerous ways. One way is to classify the quantities in the problem into known quantities (the values given in the text of the problem), wanted quantities (the values that need to be found) and auxiliary quantities (values that may need to be found as intermediate stages of the problem). Word problems are a common way to train and test understanding of underlying concepts within a descriptive problem, instead of solely testing the student's capability to perform algebraic manipulation or other "mechanical" skills (Verschaffel, 2001, p21).

However, other researchers (Kenney & Silver, 2007; 1981; Robert, Daniel & Dickson, 1999; John, 2004) summarized the types of word problems into two which are routine and non-routine. Routine problems involve an application of a mathematical procedure in much the same way as it was learned. Non-routine problems often require more thought because the choice of mathematical procedure to solve them is not obvious. The routine and non-routine in our view should be taken as categories of word problems and not types of word problems. The understanding of the types or categories of word problems can help students to deal with word problems in general.

Strategies in Solving Word Problems

There are a lot of strategies for solving word problems. The strategies used in solving word problems are same as those used in problem solving. As such it is not unusual to find problem solving strategies used in this research since word problems are considered to be a subset of problem solving in mathematics. The literature below presents some strategies proposed by Dickson (1999) and other researchers as strategies for solving word problems. However,

no one strategy is good for all problems as some problems may require the use of multiple strategies. Again each strategy might be good for a particular level of students and might not be a problem to another level of students.

Act It Out.

According to Dickson (1999), acting the problem is a method that involves asking students to demonstrate the problem themselves or use objects to demonstrate the problem. When students act the problem or role play the problem, they understand it clearly and the solution becomes obvious as they can see and feel the result of the problem from the activities. However, this strategy is limited in its usage as it can't be used in solving all word problems (Smith, 2004). This method of solving word problem is suitable for basic five or six pupils. A sample question under this could be that; six children are standing at the teachers' desk. Five more children join them. How many children are at the teacher's desk then? This question could easily be acted out by the pupils. However, when they are faced with problems like: I counted 7 bicycle riders and 19 motor bikes go pass my house this morning. How many bicycles and how many motorbikes passed that day? This question would certainly be difficult for students of basic five and six to use "the act it out" method to solve.

Make a Drawing

Solving word problems commonly involves making mathematical models of the questions, where data and information about a certain system is given and a student is required to develop a model (Duncan 2001). Examples: (l) Jamila has GHc5 and she uses Ghc2 to buy a book. How much does she have now? (2) If the water level in a cylinder of radius 2 m is rising at a rate of 3m per second, what is the rate of increase of the volume of water? According to Duncan (2001), these examples are not only intended to force the students into developing mathematical models on their own, but may also be used to promote mathematical interest and understanding by relating the subject to real-life situations. The relevance of these situations to the students varies. The situation in the first example is well-known to most people and may be useful in helping primary school students to understand the concept of subtraction. The second example, however, does not necessarily have to be a "real-life" situation to a senior high school student who may find that it is easier to handle.

Look for a Pattern.

This method according to Sullivan and White (2004) requires the students to identify the pattern or patterns within the problem and try to draw a table for the given values which will help them solve the problem. For example, how long would it take to spread a rumour in a school of 729 students if each student who hears the rumour told it to 3 new students every 15 minutes? This question is suitable for SHS2 students. To solve this problem, the students may draw tables to see the pattern before solving it. The suitable table could be as follows:

Table 1

Time (Minutes)	Numbers of students who heard the rumour	Total number within a given Time
15	3	3
30	3x3	9
45	3x3x3	27
60	3x3x3x3	81

Identify Wanted, Given and Needed Information

Identifying the wanted, given and needed information is one of the strategies of solving word problems which is most recommended. It is widely used by textbook writers. Students are encouraged to sort out the relevant information within a word problem and see how they relate the given information to the needed and wanted information in order to get a solution to the problem (Meiring, 2009; Smith, 2004; Dickson, 1999). The facts needed here are found from the relevant information available in the problem. According to Xenofontos (2007), an adjunct to this information oriented strategy is to provide experiences in which the child must formulate the question to be answered. This situation parallels many everyday problems, where you must ask questions before you begin working on a solution.

II. METHODS AND PROCEDURES

The Action Research designed was used for the study. This is because the study was about helping students to develop interest so as to overcome their difficulties in solving word problems involving linear equations in one variable. Action research involves identifying a classroom problem and devising a technique to solve the problem using scientific methods (Kanne, 2004) hence the choice of the action research method. Population of the study consisted of students of Tamale Business Senior High School. The purposive sampling technique was used in the study. In all, 2H class made up of seventy (70) students consisting of 44 Boys and 26 Girls were purposively selected for the study.Studentsin 2H class have more difficulties in mathematics than the other classes hence the choice of the class.

Test and interview were the main instruments used for the study. Pre-test was conducted to establish the students' difficulties in solving word problems involving linear equation. Ten questions were given to students to solve. Of the ten questions, five required direct translation of the words into an equation and the other five required some higher level of thinking before the solution processes. A post-test was also conducted after administering an intervention to find out how the researchers' intervention has assisted students in their learning.Also seven students based on their performance in the pre-test were interviewed. This number was taken as a result of the challenges associated with organizing and managing large qualitative data from interviewees. Each interview lasted between 20 — 25 minutes.

The quantitative data was analyzed using descriptive statistics. Simple frequency counts and Percentages were used to analyze the results. The interview data which was mainly qualitative was word-for-word transcription of all the interview responses from each of the seven interviewees. The analysis was reported using narrative style with embedded direct quotations which revealed participants depth of emotions and their thoughts about solving word problems.

III. RESULTS AND DISCUSSION

The study was designed to help SHS2 students to overcome their difficulties in solving word problems involving linear equations. Seventy (70) students made up of 44 males and 26 females were involved in the study. Data were collected through pre-test, post-test and interviews. The two research questions that guided the study were:

Research question 1. What are some of the difficulties students at the Senior High School face in dealing with word problems involving linear equations?

From Table 2, it could be seen that out of the 70 students, nobody scored marks over 60%. Only 4 students made up of 3(4.3%) males and 1(1.4%) female could score between 50 and 59. This number represents 5.7% of the sample size of 70 students. Also, out of the 70 students, only 15, made up of 11(15.7%) males and 4(5.7%) females scored between 40 and 49 which represent 21.4% of the total students involved in the study. Most of the above students were able to solve routine problems like; "I think of a number. I multiply it by 5 and add 15. If the result is 100, what is the number? And find a number such that when it is tripled and 7 added the result is 25". However, they found it extremely difficult to solve a non-routine problem like; A worker gets 6 cedis per hour for ordinary time and 9 cedis per hour for overtime. If she gets 324 cedis for 50 hours in a week, how many hours was overtime?

Results from the pre-test clearly showed that items one, two, and three which are routine word problems were answered very well by most students. Out of the seventy (70) students, more than half were able to answer the items effectively. This performance goes to confirm the assertion by John (2004) that students could easily solve routine word problems whose formula to use is obvious.

For items 4 and 5 those who were able to answer the questions very well were less than half of the students even though those two items were also routine word problems. The students were not able to identify the patterns within these problems before solution and hence the wrong answers. Students, performance in these items is not consistent with the findings of Sullivan and White (2004) that students need to identify the pattern or patterns within a problem and try to draw a table for the given values which will help them solve the problem. In the case of item 6, only 14 students out of the 70 students could solve the question half-way. The number represents 20% of the total students involved and does not indicate a good performance from students. The non-routine word problem was on how to find one side of a triangle given one the perimeter. The required formula was; $p = a + b + c$. However, many students used $p= 2 (a + b + c)$ and some also used $p = 3(a + b + c)$ instead of $p= a + b + c$. In this question, students did not understand the problem as posited by Classman (2006) that Students need to understand the word problem properly before solution if they want to succeed.

In the case of item 7, most students did not attempt it in the pre-test and the few who attempted it could not score any significant mark. This question was a non-routine word problem. Students' performance in this question goes to further confirm the assertion that non-routine word problems whose formula to use is not obvious is difficult for students to solve (Schoenfeld, 2002). The difficulty students had about this question was how to form the two linear equations $6x + 8y=324$ and $x + y=50$. Instead of the two equations, some students solved it as; $324 /50=6.48$ and others just wrote the question as the answer.

Item 8 is also a non-routine word problem. Out of the 70 students, no student was able to answer the question very well in the pre-test and this means that 100% of the students could either not attempt it or answered it wrongly. According to Classman (2006), the key components in understanding word problems include not only comprehension of the mathematical procedures but a conception of the vocabulary used as well. Instead of $x + y= 29$ and $x- y=3$, $x + y= 29$ and $3x + y=0$ were used by many students to get wrong answers. Their wrong solution was a result of wrong conceptions of the algebraic demands of the question. This shows that students did not understand the vocabulary used very well and as such they were not able to model the right equations and hence the wrong answers.

For item 9, which is also a non-routine word problem, no student was able to answer that question in the pre-test. This means that, 100% of the total students involved could either not attempt or answer the question effectively. The question required sharing money between two children but did not state if the money was to be shared equally. However most of the students shared it equally resulting in the equations $2x + 7.50 =90$ and $y2 -7.50 = 90$ instead of $x, + y = 90$ and $2x — y = 22.50$. This goes to support the findings of Classman (2006) that students need to understand the word problem concepts thoroughly if they want to succeed in mathematics.

Also in the case of item 10, out of the 70 students, no student was able to demonstrate his/her ability to solve that question. 100% of the students failed to answer that non-routine word problem in the pre-test. In student-centered learning, students learn more by doing and experiencing rather than by observing (Brown, 2008). This was not seen in this question as students were waiting to be told the answers. The question explicitly required finding the average of three numbers and the required inequality was$(70 + 76 + x)/ 3\geq 80$.

However, some students were rather finding average of two numbers because only two values were given. This conceptual misunderstanding resulted in the poor performance of the students in the pre-test. Their poor performance confirms the difficulties they faced in solving linear worded problems in the pre-test as noted by Lynch (2010).

Table 2. Results of Pre-test of Students.

Scores(100)	Male		Female		Total	
	f	%	f	%	f	%
60-100	0	0	0	0	0	0
50-59	3	4.3	1	1.4	4	5.7
40-49	11	15.7	4	5.7	15	21.4
30-39	17	24.3	4	5.7	21	30
20-29	7	10	9	12.9	16	22.9
10-19	5	7.1	2	2.9	7	10
0-9	1	1.4	6	8.6	7	10
Totals	44	62.8	26	37.2	70	100

Source: field Data, 2013

A cross- section of the students interviewed after the pre-test indicated that they;

- *are not used to solving word problems;*
- *do not trust themselves in analyzing word problems;*
- *perceive solving word problems as time-wasting since one has to read and analyze the problem algebraically before beginning to solve them;*
- *find it difficult to tackle word problems because the formula to use is not obvious;*
- *perceive word problems as difficult;*
- *fear that one can score zero if one is unable to derive the right equation for the problem;*
- *felt that some teachers do not give enough examples to develop their understanding; and*
- *felt that mathematics is about figures and not stories and so hate story problems.*

Students' comments amply suggest that they have difficulties in dealing with word problems.

Research question 2. In what ways can students' interest be developed in dealing with word problems in linear Equations?

Results from the post-test indicated that items one, two and three were perfectly answered correctly by all students as happened in the pre-test. All 70 students answered the questions correctly. Students' performance in these questions is consistent with the findings of researchers like (Dewey, 1968; Brown, 2008 and Duckworth, 2009) who posited that when students engage actively in the solution processes, they reach their highest potentials. These items were routine word problems whose formulas to use were obvious and the students demonstrated that with their performance.

For items four and five, majority of the students answered them correctly. Of the seventy students, more than 62 students in each case were able to answer those questions very well. students were able to model and solve equations generated from the two items as required. According to Lynch (2010) humans can understand only what knowledge they have constructed themselves. In the test items, majority of the students who understood them were able to solve it effectively. For item six, 50 out of the 70 students answered it effectively. This number represents 71.4% of the students who performed very well in the item. In the case of item seven, only few students could not answer it correctly. Majority of the students were able to solve it effectively with little difficulty. The question is purely non-routine and so the formula to solve it was not obvious for the few students.

For item eight, 60 out of the 70 students demonstrated their ability to solve and solved it correctly. Students' performance in this question demonstrated a significant increase as compared to the pre-test. Only 4 students representing 5.7% could not solve that question correctly. The question is also a non-routine word problem and the 4 students found it a big task to tackle. Students' performance in this question was far better than that of the pre-test. Considering item ten in the post-test, more than half of the students demonstrated their ability to solve the question effectively. This also supports the assertion by Smith (2004) that students have difficulties in solving non-routine word problems. The interview results after the intervention showed that the students no longer waste time in solving word problems as they now have the basic ideas in the solution processes. The intervention provided opportunities for students to think through and understand the process of solving word problems. This is consistent with the findings of (Baron, 2003; Le Blanc, 2002; Meiring, 2009) that, students must have time to digest or think over a problem thoroughly to understand the task required in solving the word problem. With the opportunities provided, students now understood some of the key words usually found in word problems and that made them not to be afraid of word problems any longer and this is consistent with Ellington (2002) findings.

Similarly, it was only questions seven, nine and ten that were still difficult for few students to solve since all other questions were solved effectively. This suggests that students might need more time and similar examples to solve in order to succeed in those types of questions. Nonetheless, in general, students' performance had improved significantly in the post-test. The improved performance of the students in the post-test is consistent with the findings by Huba & Freed (2008) on student-centered learning that; instead of students learning materials that have no relevance to them or their lives, they should have the opportunity to learn and use

knowledge that directly relates to their immediate environment. Majority of the students scored very high marks in the post-test as a result of the intervention process. The intervention used items within the immediate environment of students as examples. The student-centered approach which was presented using interactive method had helped students to improve their performance in the post-test.

TABLE 3 Students' scores in the post-test

	Male		Female		Total	
Marks	No	%	No	%	No	%
90-100	2	2.9	0	0	2	2.9
80-89	1	1.4	4	5.7	5	7.1
70-79	13	18.6	1	1.4	14	20
60-69	17	24.3	5	7.1	22	31.5
50-59	6	8.6	8	11.4	14	20
40-49	5	7.1	8	11.4	13	18.5
0-39	0	0	0	0	0	0
Totals	44	63	26	37	70	100

Source: field work 2013

IV. CONCLUSIONS

Base on the findings above, the following conclusions were drawn:

- Students had difficulties in solving non-routine word problems
- Students had difficulties in identifying patterns in problems before solutions
- They also had difficulties in analysing and transforming word problems into Algebraic Expression and then into linear Equation in variable.
- Students involvement in solving many examples in word problems enhance their interest in dealing with word problems relating to linear equations in one variable

V. RECOMMENDATIONS

Following the conclusions, the researchers made the following recommendation.

- Mathematics Teachers should involve students in series of non-routine word problems so as to enhance their approach in solving non-routine word problems relating to linear equations in one variable.
- Mathematics Teachers at the Senior High School level should engage students more in topics relating to identifying patterns in word problems.
- Mathematics Teachers and students should use real life problems and concrete materials in analysing and transforming word problems into Algebraic Expressions then to linear equations
- Mathematics teachers should encourage students to develop the habit of solving many examples on word problems involving linear equation in one variable

REFERENCES

[1]. Anamuah-Mensah, J., Mereku, D K., &Asabere-Ameyaw, A. (2004). Ghanaian Junior secondary school student' achievement in Mathematics and science: Results from Ghana's participation in the 2003 Trends in International Mathematics and Science study (TIMSS-2003. Accra: Ministry of Education.

[2]. Anamuah-Mensah, J., Mereku, D. K., &Asabere-Ameyaw, A. (2008). TIMSS-2007 Ghana Report: Findings from IEA'S Trends in International Mathematics and Science study at Eighth Grade. Accra: Ministry of Education.

[3]. Aseidu-Addo, S.K, &Yidana, I. (2000). Mathematics teachers' knowledge of the subject content and Methodology. *Journal of the Mathematics Association of Ghana*. 12 (65-71).

[4]. Baron, M. E. (2003). Implication of cognitive theory for instruction in word problem solving. *Review of Educational Research, 54, 363-407.*

[5]. Brown, J.K. (2008). *The art of problem posing.* Hillsdale, NJ: Lawrence Erlbaum.

[6]. Classman, B.A. (2006). *Focusing on Informal Strategies when Linking Arithmetic to early algebra*. Educational studies in mathematics, 54, 63 – 75.

[7]. Dewey, J. (1968). *How to think: A restatement of the relation of reflective thinking to the educative process.* Boston: Health.

[8]. Dickson, R. (1999). Current issues and problems in mathematics teaching. In M. Cornelius (Ed). *Teaching Mathematics* (pp. 1-16). New York: Nichols publishing company.

[9]. Duckworth, J. R. (2009). Problem based learning: An instructional model and its constructivist framework. *Educational Technology*, 35 (5), 31-38.

[10]. Duncan, N. (2001). Exploration of students' mathematical beliefs and behaviour. *Journal for Research in Mathematics Education, 20, 338-355.*

[11]. *Ellington, M. (2009). Mathematical problem solving characteristics of Middle school students with learning disabilities. The Journal of special Education, 27, 175-201.*

[12]. Fong, T. (2002). Teaching problem solving in physics: The psychological principles in practice: designing classroom. In F. Reif & D. Tuma (Eds.), *Problem solving in education: Issues in teaching and research.* Hillsdale, NJ: Lawrence Erlbaum.

[13]. Heather, K. J. (2005). Conceptual and Procedural Understanding of Algebra Concept in Middle Grades. Texas A & M University.

[14]. Huba, M.E, & Freed, J.E. (2000). Teacher-centred vs. learner-centred paradigms. Retrieved from; *http://assesment.uconn.edu/docs/TeacherCenteredVsLearnerCentered.*

[15]. John, L. (2004). Mathematical problem solving. Orlando, FL; Academic Press.

[16]. Kannae, L. A. (2004). Research skills capacity building for National Teachers' Organization-Training manual. *Pan African Teachers Centre, Togo.* P.11.

[17]. Kenney, M. S., & Silver, T. L. (1981). Development of children's problem-solving ability in arithmetic. In H. Ginsburg (Ed.), *The Development of Mathematical Thinking* (pp. 153- 200). New York: Academic Press.

[18]. Kenney, M. S. & Silver, T. L. (2007). A picture is worth a thousand numbers in solving math word problems. *Centroid*, 17, 18-19.

[19]. Lambdin, D. V. (2001). Benefits of teaching through problem solving. In F.K. Lester & R. Charles(Eds.). *Teaching mathematics through problem; pre-kindergarten grade 6*(pp. 3-13). Reston, VA. National Council of Teachers of Mathematics.

[20]. Le Blanc, T. R. (2002). Representation and translations among representations in mathematics learning and problem solving. In C. Janvier (ED), *Problems of representation in the teaching*

and learning of mathematics (pp. 33-40). Cambridge University press.

[21]. Lynch. D. N. (2010). Student-centred Learning: The Approach that Better Benefits Students Virginia, Wesleyan college. INST 482. Retrieved: April, 21, 2010. From: http://global.umi.com/pqdweb

[22]. Madis, L. (2009). *Algebraic Word Problems:Role of Linguistics and Structural Variables,* Educational Studies in Mathematics, 41(1). Retrieved on June, 15, 2010 from: http://links.jstor.org/sici?sici

[23]. Mering, S. P. (2007). *Problem Solving-A Basic Mathematics Goal.* Columbus, Ohio: Ohio Department of Education. Seymour Publications.

[24]. Ministry of Education (2002) Ghana Educational Reforms Commissions Report: Meeting the challenges of Education in the Twenty-first century. Anamuah-Mensah's Commission, Ghana

[25]. Ministry of Education (2007). Teaching syllabus for Mathematics for Senior High Schools in Ghana. Curriculum Research, And Development Division, Accra.

[26]. National Institute for Literacy (2005). Partnership for Reading vocabulary. Available at the URL: www.nifl.gov/partnership.forreading on July, 31, 2010.

[27]. Nokoe, K.S. (2007). Mathematics Application in Life Science, and future. *Keynote Address of the Mathematics Association of Ghana Conference at Ho, Ghana.* On the 4th of July 2007.

[28]. Nokoe, K.S. (2009). The duration of secondary Education: Its implication on the teaching and learning in Ghana. Keynote Address on the occasion of the annual conference of the Mathematical Association of Ghana at the GNAT conference Hall, Tamale, Ghana on Tuesday September 1, 2009.

[29]. Pooran, P. S. (2010). Teaching word problem in English to second language grade8 in South Africa. (ICERI 2010). Retrieved on July, 31, 2010 from: http://library.iated.org/view/pooran2010TEA.

[30]. Robert, S, Daniel, N. & Dickson, S. (1999). *Advance Algebra. Research idea for the classroom.* Reston, VA: National Council of Teachers of Mathematics.

[31]. Scafer, L (2005). An introduction to cognitive process instruction. In J. Lochhead& J. Clement (Eds.) *Cognitive process instruction* (20-23). Philadelphia, PA: Franklin Institute Press.

[32]. Schoenfeld, A. H. (2002). Can heuristics be taught? In J. Lockhead (Ed), *Cognitive process instruction* (418-420) Philadelphia, PA: Franklin Institute Press.

[33]. Schoenfeld, A. H., &Arcavi, D. (2001). Problem perception and knowledge structure in expert and novice mathematical problem solvers. *Journal of Experimental Psychology: Learning Memory and Cognition, 8, 484-494.*

[34]. Schroeder, J. & Lester, F. K. (1989). Metacognition, cognitive monitoring, and mathematical performance. *Journal for Research in Mathematics Education, 16, 163-176.*

[35]. Smith, J. P. (2004). *The effects of general versus specific heuristics in mathematical problem solving tasks* (Columbia University, 1973). Dissertation Abstracts International.

[36]. Sullivan, D., & White, C. (2004). *Reconstructing Mathematics Education: Stories of teacher meeting the challenge of reform.* New York: Teachers' college press.

[37]. Suydam, M. N. (2002). *Powerful principle of instruction.* London: Longman Publishers.

[38]. Suydam, M. N., & Weaker, J. F. (2001). *Using Research: A key to Elementary Mathematics.* Columbus: ERIC.

[39]. The BTH Educational Group (2011). Strategies in solving mathematics word problems. Retrieved from URL: http://www.6theducation.ca/study-tips/strategies-for-solving-math-word-problem.html On july,12,2011.Unified Science and Mathematics in the Elementary school Project (USMES) Guide (2004). Fitting problem solving into every classroom. Newton: Mass Education Development Centre.

[40]. Verschaffel, W. R. (2001). *Cognitive and thought.* New York: Wiley.

[41]. Xenofontos, C. (2007) Teachers' beliefs about mathematical problem solving, their problem solving competence and the impact on the instruction: *The case of Ms Flectra, a Cypiotprimary teacher. British Society for research into learning Mathematics,* 27(3), 120-125.