



Assessment On Errors and Misconceptions in ... Umar, S. & Galadima U. (2025)

Assessment on Errors and Misconceptions in Solving Algebraic Word Problems among Senior Secondary Schools Students in Sokoto State, Nigeria

UMAR, Sabiu¹

usabiu2015@gmail.com

07031801215

GALADIMA, Usman²

usman.galadima@ssu.edu.ng

+2348089757540

¹Federal College of Education, Katsina

²Sokoto State University, Sokoto

Abstract

This study assessed the errors and misconceptions in solving algebraic word problems among senior secondary schools students in sokoto state, Nigeria. The purpose of the research was to identify the categories of errors and explore the misconceptions made by senior secondary school students in solving algebraic word problems in Sokoto State, Nigeria. A descriptive survey research design was adopted using mixed method which is characterized by the collection and analysis of quantitative data followed by the collection and analysis of qualitative data. Data were collected from a sample of 378 Students which selected based on the total number of 32,298 SSII students in the 142 public senior secondary schools across the six education zones in the State using stratified random sampling. Two research instruments, Students Algebraic Word Problem Errors Test (SAWPET) was administered for quantitative data collection and Students Algebraic Word Problem Interview Protocol (SAWPIP) for qualitative data collection were used to gather data. The reliability coefficients of SAWPET and SAWPIP were 0.82 and 0.86 respectively. Data collected were analyzed using descriptive statistics and thematic content analysis. The major findings of this study includes: Most of the students had difficulties in understanding algebraic word problems and Most of the errors committed by students are not ordinary errors rather are misconceptions. Based on these findings it was recommended that Mathematics teachers should involved their students in activities that will aid their learning and thinking process. These will make students to be conscious of the various Algebraic word problems and improve to overcome their errors and misconceptions.

Keywords: Algebraic Word Problems, Errors, Misconceptions, Algebra.

Introduction

Algebra is a fundamental branch of Mathematics that plays a crucial role in developing students' logical thinking and problem-solving skills. Algebra as a Mathematics content domain has been recognized as a key for successful functioning of all aspects of human endeavor and that no country can achieve any development of scientific and technological advancement without it. Algebraic word problems are verbal descriptions of problem situations in which the questions can be answered by the application of mathematical operations to numerical data contained in the description of the problem (Iilonga & ogbonnaya, 2023). Algebra is found in many areas of life and one of the most important areas of senior secondary school Mathematics. But, despite of its importance, students find it difficult to understand simple algebraic concepts such as variables, expressions, and equivalence. Although, basic algebraic concepts are introduced at the elementary and high school levels, some students have difficulties in understanding algebra because they find it more abstract than any other field of Mathematics (Few, 2010). It is argued that word problems have traditionally been difficult to many Algebra students. The primary source of difficulty for students in solving algebraic word problems is translating the story in to appropriate algebraic expressions (Rojano and Puig, 2007). However, Bishop (2008), further claimed that students' difficulties in translating from natural language to Algebra and vice versa is one of the situations that generally for the students.

An error is the deviation from a correct solution of a problem as contextualized in Mathematics. Errors could be found as a wrongly answered problems which have flaws in the process that generated answers (Stemele & Jina Asvat, 2024). Mathematics teachers can directly teach the correct procedure for solving and doing Mathematics correctly. While, there are common errors that students made with performing algebraic processes, students may demonstrate errors that are individual specific (Akissani, Kajuru, Falalu & Aliyu, 2025). Error for inability in understanding the word problem is that



Assessment On Errors and Misconceptions in ... Umar, S. & Galadima U. (2025)

students simply understand the problem but do not actually capture the information contained in the question (Haerani, Novianingsih & Turmudi, 2021; Wijaya et, al., 2014) so that the student cannot process further solution from the problem. Thus, Abdullah, Abidin, and Ali (2015) stated errors of understanding or comprehension errors occurs when students can read questions but fail to understand what is asked and needed. Whereas, some other students comprehend algebraic word problems as a substitute for something whose value is unknown (Haerani, Novianingsih & Turmudi, 2021). Students who fail to master the necessary skills and ideas at any level of learning, can influence their achievement at the next level. Hence, it is vital for a teacher to make an assessment of teaching and learning in the classroom and try to identify the difficulties and errors that are often experienced by students.

Misconception on the other hand, is a view or opinion that is incorrect based on faulty thinking or understanding of mathematical concepts. The word misconceptions is an idea that is wrong because it is based on a failure to understand a concepts. (Obunge & Adolphus, 2024; Pramesti & Retnawati, 2019; Tekin-Sitrava, 2017). Similarly, misconception indicates a person's wrong understanding, and it occurs repeatedly because it is resistant and can produce wrong results (Tooher & Johnson, 2020). In view of this, the present study deemed it necessary to investigate students' errors and misconceptions which need to provide clear a explanation about the state of situation in Sokoto state, for better selection of an appropriate approach to minimize the problem for better learning outcomes and improve algebraic thinking ability of the learners.

Statement of the Problem

Algebra is found in many areas of solving certain types of everyday life problems and one of the most important component of senior secondary school mathematics. But, despite of the importance of mathematics to nation building, scientific and technological development, it is still notable that students performance in mathematics at internal and external examinations has remained considerably poor and some of the reasons for students' poor performance of Mathematics in secondary schools are lack of understanding of some difficult Algebraic topics in mathematics Curriculum. Over the years, the West African Examinations Council (WAEC) Chief Examiners' reports on Mathematics in Nigeria observed that candidates continue to perform poorly in questions involving algebraic word problems. Consequently, students' errors and misconceptions made by students in solving algebraic word problems are the major identified problems in Sokoto State (Inweregubh, 2018). Due to the above problems of Students poor performance in Algebra and limited research-based evidence in Sokoto State make the researcher of this study to investigate the Errors and Misconceptions Students' committed in solving algebraic word problems.

Objectives of the Study

This study have the following objectives:

1. To identify the categories of Errors made by Senior Secondary School Students in solving Algebraic word problems in Sokoto State, Nigeria.
2. To explore the Misconceptions made by Senior Secondary School Students in solving Algebraic word problems in Sokoto State, Nigeria.

Research Questions

The following research questions guided this study:

1. What are the categories of errors made by senior secondary school students in solving Algebraic word problems in Sokoto State, Nigeria?
2. What are the misconceptions made by senior secondary school students in solving Algebraic word problems in Sokoto State, Nigeria?

Methodology

This study employed a descriptive survey research design using mixed method which is characterized by the collection and analysis of quantitative data followed by the collection and analysis of qualitative data. The population of this study comprised all the 32,239 students from the 142 public senior secondary schools II in Sokoto State. However, the samples size of 378 Students were selected using the table for determining sample size from given population. The instrument for data collection used in this study consists of two different types of instruments. namely, Students Algebraic Errors Test (SAET) were used to collected quantitative data. The qualitative instrument, algebraic misconceptions interview

Assessment On Errors and Misconceptions in ... Umar, S. & Galadima U. (2025)

questionnaire (AMIQ) was used to explore students' misconception based on their answers obtained from the quantitative part. The purpose of interviewing is to enable the respondents to spell out their understanding of the concept (Best and Kahn, 2012). The interview was conducted two weeks after the test, and two (2) students were interviewed from selected school to identify their Misconceptions on the concept. The interview lasted between 20 to 30 minutes. Voice-recorder via the smart phone were use and later transcribed. The instrument was validated by experts and the reliability coefficients of SAET and AMID were obtained as 0.82 and 0.86 respectively. Data collected were analyzed using descriptive statistics and thematic content analysis.

Presentation of Results

The results were presented based on the research questions as follows:

Research Question One:

What are the categories of Errors made by Senior Secondary School Students in solving Algebraic Word Problems?

Based on the analysis of the students' worksheet, the category of errors identified are presented in Table 1 below.

Table 1 Categories of Errors in solving Algebraic Word Problems.

S/N	Type of Errors	Number of Participants	Number of Incorrect Answers	Percentage (%)
1	Inability in understanding the problem	378	132	35
2	Incomplete Solution.	378	55	14
3	Mistake made in solution by calculation or notation.	378	72	19
4	Inability to Formulate Equation.	378	32	8
5	Guessing Without Reasoning	378	203	54
6	Difficulty in Checking the Solution.	378	12	3

Table 1 shows that the most high incorrect answer of errors in solving algebraic word problems is guessing without reasoning 203(54%) which indicated that students may not fully understand the concept of algebraic word problems by just guessing the answers without making any process or calculations. The second most common error 132(35%) is inability in understanding the problem; mistake made in solution by calculation or notation 72(19%). These errors indicated that students struggles with difficulties in solving algebraic word problems which is also fundamental concept in Algebra. Other errors included the incomplete solution 55(14%), inability to formulate equation 32(8%) and difficulty in checking the solution 12(3%). These identified errors reveals that students might not have a solid foundation in algebraic concepts and might struggle with applying them to solve problems related to word problems. As such, the types of categories of errors were shown in the Figure 1 below that provides a sample of students' scripts and their errors in understanding of algebraic word problems.

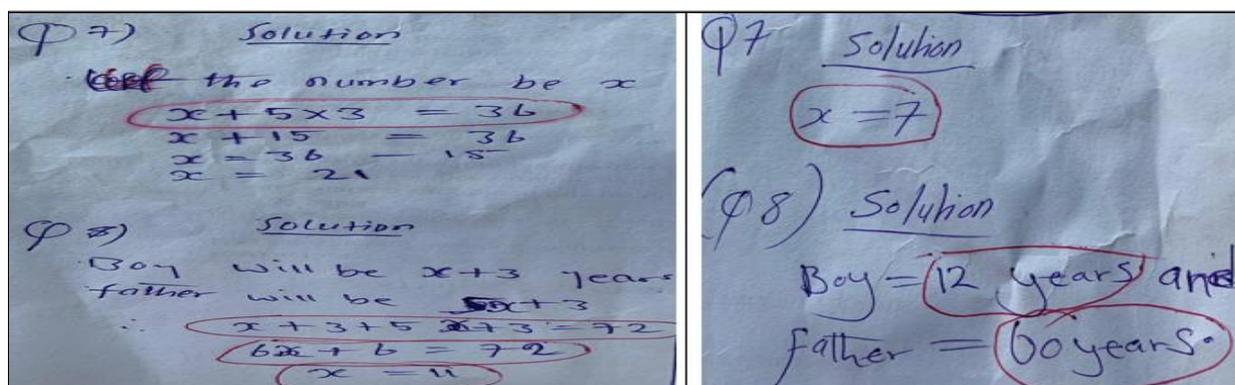


Figure 1: Sample of Students Scripts based on question 7 and 8.

Figure 1 above, provide a sample of students scripts and their errors in solving algebraic word problems. it can be observed that students guessed without reasoning in solving questions of algebraic word problems. Many of the students solved the question by guessing the answer as $x=7$ as well as guessing that the Boy=12ys and father=60ys which was categorised as guessing without reasoning. However, another error which students committed on this question was inability in

Assessment On Errors and Misconceptions in ... Umar, S. & Galadima U. (2025)

understanding the problem, where some students found it difficult to comprehend the problems in question 7 and 8. Incomplete solution was one of the identified errors in algebraic word problems where some students found it difficult to complete their solution process in solving questions related to word problem.

Below in the Table 2 shows the percentages and mean percentage of incorrect responses for algebraic word problems.

Table 2 Percentages and Average percentage of incorrect responses on Algebraic word problems

Question Number	Number of respondents	Number of Incorrect Responses	Percentage (%)	Average percentage
7	378	254	67	76
8	378	323	85	

Table 2 presented the percentages and average percentage of incorrect responses for algebraic word problems. The Table revealed that 76% of the respondents out of 378, answered the questions incorrect in solving questions related to algebraic word problems.

Research Question Two

What are the Misconceptions made by Senior Secondary School Students in Solving Algebraic Word Problems?

To answer the research question 2. The data was obtained in two ways such as students' answers to the test, and interviews with the two students (S_1 and S_2) were R stands for researcher while S stands for the student who was the interviewee. The sub-section below analysed the interview transcript of S_1

Interview transcript with the S_1 .

S_1 had some misconceptions in solving algebraic word problems by answering question 7 which given as: Think of a number, add 5 to it and multiply the result by 3, the answer is 36. What is the number?. S_1 responded to this question as: $X+5 \times 3 = 36$, $X+15=36$, $x=21$. as seen in figure 2 below.

Figure 2: Extract of S_1 Question 7.

Figure 2 extracted from S_1 . The answer given in the transcripts was by far contrary to the expected answer. The interview was carried out in order to find out about the S_1 understanding about the algebraic word problems. The following shows the interview questions and responses with the S_1 and the researcher: R: Can you work out Question 7?; S_1 : Yes sir.; R: Okey, go ahead.; S_1 : Let the number be X, add 5 to it is $X + 5$, multiply the result by 3 will be $x + 5 \times 3$ the answer is 36 will be $x + 5 \times 3 = 36$, then, multiply 5 by 3 gives 15 ie $x + 15 = 36$.; R: Yes you try but the question says multiply the result by 3 while you multiply 5 by 3, Do you mean 5 is the result?; S_1 : No sir, the result is $x + 5$ but the multiplication affected only 5; R: Okey, which notation do you think, when use it, the multiplication will affect all the result?; S_1 : I don't know sir.; R: Is it not bracket?; S_1 : I am not sure.; R: Okey, try it and see.; S_1 : $(x + 5)3 = 3x + 15$. Yes sir it worked.; R: Could your answer still be $x = 21$?; S_1 : No sir.; R: Okey, work it again.; S_1 : $3x + 15 = 36$, $3x = 36 - 15$, $3x = 21$, $x = \frac{21}{3}$, $x = 7$.; R: Good, which answer is the best for you? $x = 7$ or $x = 21$?; S_1 : $x = 7$.; The S_1 answer shows that there is lack of understanding the concepts of bracket and other operations (multiplication and addition) by not perceiving the correct affectation of bracket and multiplication.

Interview transcript with S_2

The S_2 had some misconceptions in solving algebraic word problems by answering question 7 which given as: Think of a number, add 5 to it and multiply the result by 3, the answer is 36. What is the number?. S_2 responded to this question as: $X = 3$, $X = 7$ and in question 8 answered boy = 12 and father = 60 without any calculation. as seen in figure 3 below.

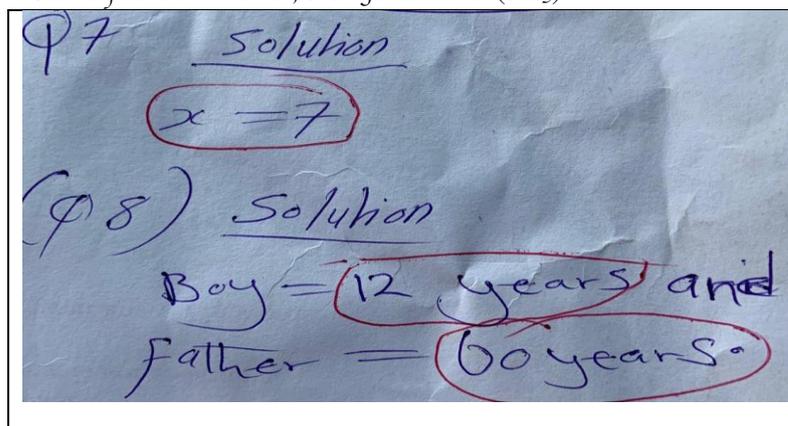


Figure 2: Extract of S₂ Question 7 & 8.

The researcher decided to interview S₂ in order to find out more from the misconceptions. The following shows the interview questions and responses with the S₂ and the researcher: R: Can you work out Question 7 & 8?; S₂: Yes sir.; R: Okey, go ahead.; S₂: Q7. X=7, Q8. Boy is 12 years and his father is 60 years.; R: How did you get the answer?; S₂: I just guest answer; R: I you sure the answer is correct?.; S₂: No but I expect it to be correct.; The S₂ answer shows that there is lack of understanding the concepts and procedure of solving algebraic word problems by just posting and guessing the answer without any calculations.

Discussion of Findings

The findings of this were discussed based on the identified categories of errors related to understanding of algebraic word problems. The inability in understanding the problem was observed when 67% in Q7 and 85% in Q8 of the students found it difficult to comprehend the problems as their answers was 'I don't know and I don't understand'. In the past, many empirical studies indicated that students face difficulties in translating algebra word Problems that found that the error made by students were including the aspects of comprehension error for the inability to understand the algebraic word problems. This finding emphasized previous researches (Haerani, Novianingsih & Turmudi, 2021; Ogbu, 2025; Wijaya et al., 2014) that comprehension errors and guessing, difficulty in checking the solutions are the most dominant errors made by students in solving word problems. This is supported by the statements of Abdullah, Abidin, and Ali (2015) that errors of understanding occur when students can read questions but fail to understand what is asked and needed that lead to incomplete solution of the questions.

Lastly, students' difficulty to checked their solution process to actualized the correct answer in solving questions related to word problem as some of their final answers were wrong or committed a small mistake at the middle of the process which is very easy to identify and corrected if proper checked. To address this, Bishop, Filloy and Puig (2008) claimed that students' misconceptions in translating from natural language to algebra and vice versa. He further said that students found it difficult to complete their solution process in solving question related to word problem as their answers was incomplete when some students terminated the process somewhere in the middle without reaching the final answer and probably they may not know how to proceed further.

Conclusion

It appears from the discussion of the students' responses found comprehension error for the inability to understand the algebraic word problems and their difficulties to complete their solution process in solving question related to word problem as their answers was incomplete when some students terminated the process somewhere about reaching the final answer and probably they may not know how to proceed further. Also, it has been observed that the students' inability to do word problems is affected by their inability to comprehend the problem at the first place, this discourages them from further attempting to solve the problem.

Recommendations

Based on the findings of the study, the following recommendations were made:



Assessment On Errors and Misconceptions in ... Umar, S. & Galadima U. (2025)

1. It is recommended that teachers should involve their students in activities that will aid their learning and thinking process. These will make students to be conscious of the various Algebraic concepts and improve to overcome their errors and misconceptions.
2. It is recommended that the curriculum implementers who Prepare teachers for pre-service and in-service training should lay emphasis on best teaching method so as for the students to overcome all these Errors and Misconceptions.

References

- Akissani, I., Kajuru, Y.K., Falalu, M.K. & Aliyu, Z. (2025). Effect of Metacognitive Self-Assessment in Algebra Among Senior Secondary School Students, Dutsin-ma Educational Zone, Katsina State, Nigeria. *Nightingale International Journal of Educational Research and Development*, 7 (8), 116-136. ISSN: 3027-1215.
- Best, J. W. and Kahn, J. V. (2012). *Research in education* (10thed). New Delhi: Pearson
- Bishop, A., Filloy, E., & Puig, L. (2008). Educational algebra: A theoretical and empirical approach. Boston, MA, USA: Springer
- Egodawatte, G. (2011). *Secondary School Student's Misconceptions in Algebra*, (Unpublished Ph.D Thesis) University of Toronto, Canada.
- Few, K. (2010). Students' understanding of Algebraic notation: 11-15, Educational studies in mathematics, Vol. 33, pp. 1-19.
- Fitria, A., & Susanto, H. (2023). Cognitive Map: Diagnosing and Exploring Students' Misconceptions in Algebra. *Mathematics Teaching Research Journal*, 15(5), 49-75.
- Ilonga, H. K., & Ogbonnaya, U. I. (2023). Grade 10 Namibian learners' strategies for solving algebraic word problems. *Unnes Journal of Mathematics Education*, 12(2), 103-113.
- Haerani, A., Novianingsih, K., & Turmudi, T. (2021). Analysis of students' errors in solving word problems viewed from mathematical resilience. *JTAM (Jurnal Teori dan Aplikasi Matematika)*, 5(1), 246-253.
- Inweregbugh, O. C. (2018). Influence of School Categories on the Performance of Senior Secondary School Students in Algebraic Equations in Sokoto State, Nigeria. *African Journal of Science Technology and Mathematics Education*, 4(1), 107-117.
- Mayer, R. E. (1982). Memory for Algebra story problems. *Journal of Educational Psychology*, 74, 199-216.
- Ndemo, Z., & Ndemo, O. (2018). Secondary school students' errors and misconceptions in learning algebra. *Journal of Education and Learning (edulearn)*, 12(4), 690-701 ISSN: 2089-9823.
- Obunge, J.I. & Adolphus, T. (2024). Identification of Misconceptions in Geometry among Senior Secondary School Students in Port Harcourt Metropolis. *Rivers State University Journal of Education*, 27(2), 79-87. ISSN: 2735-9840
- Ogbu, S. (2025). Assessment of Secondary School Students' Difficulties in Translating Word Problems into Algebraic Equations. *Journal Plus Education/Educația Plus*, 37(1), 302-322.
- Pramesti, T. I., & Retnawati, H. (2019). Difficulties in Learning Algebra: An Analysis of Students' Errors. *Journal of Physics: Conference Series*. 1320 (1), 1-7. doi:10.1088/1742-6596/1320/1/012061
- Rojano, T., and Puig, L. (2007). Educational Algebra: A theoretical and empirical approach. Berlin Heidelberg, New York: Springer.
- Siagian, M. D., Suryadi, D., Nurlaelah, E., Tamur, M., & Sulastri, R. (2021). Investigating Students' Concept Image in Understanding Variables. *Journal of Physics: Conference Series* 1882 (1) 1-6. doi:10.1088/1742-6596/1882/1/012058
- Stemele, B.P. & Jina Asvat, Z. (2024). Exploring Learner Errors and Misconceptions with Grade 9 Learners Through the use of Algebra Tiles. *African Journal of Research Mathematics, Sciencer and Technology Education*, 28(1), 153-170. <https://doi.org/10.1080/18117295.2024.2334989>
- Tekin-Sitrava, R. (2017). Middle Grade Students' Concept Images of Algebraic Concepts. *Journal of Education and Learning*, 6(3), 299-304. ISSN 1927-5250
- Toohar, H., & Johnson, P. (2020). The Role of Analogies and Anchors in Addressing Students' Misconceptions with Algebraic Equations. *Issues in Educational Research*, 30(2), 756-781
- WAEC, (2020-2025). *West African Examination Council. May/June Chief Examiner' Reports for Mathematics* <http://www.waeconline.org.ng>
- Wijaya, A., van den Heuvel-Panhuizen, M., Doorman, M., & Robitzsch, A. (2014). Difficulties in solving context-based PISA mathematics tasks: An analysis of students' errors. *Mathematics Enthusiast*, 11(3), 555-584.