# Difficulty and Performance of Aviation Students in Translating Worded Statements into Mathematical Symbols

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## Abstract

The language of Mathematics depends so much on symbols and notations. Mathematical problems are stated in words and have to be translated into algebraic or mathematical expressions in terms of symbols and notations. Unless translated accordingly, it is only then that the student can solve the problem correctly. Thus, this research sought to identify the difficulties encountered and the level of performance in translating algebraic worded statements into algebraic expressions of the 3rd year students of the four campuses of Philippine State College of Aeronautics. A descriptive quantitative method of research was employed using a researcher-made questionnaire consisting of a 20-item problem solving test involving the four fundamental operations of mathematics which was given during the preliminary period of the 1st Semester 2016-2017. Scores in this test measured their performance level in translating worded statements while interpretation of their mistakes identified their difficulties in translating worded statements. Results indicate that the respondents are below in the satisfactory level in translating worded statements. Carelessness, lack of comprehension, interchanging values, and unfamiliar words are some of the common difficulties encountered by the respondents in translating worded problems.

**Keywords** : Mathematics Difficulties ; Problem Solving Skills ; Translating Worded Statements into Mathematical Symbols, Level of Performance

## บทคัดย่อ

ภาษาทางคณิตศาสตร์ใช้สัญลักษณ์และข้อความต่างๆ เป็นอย่างมาก โจทย์ทางคณิตศาสตร์ต่างๆ ได้ถูกระบุไว้เป็นคำพูดและต้องถูกแปลเป็นสำนวนที่เกี่ยวกับพีชคณิตหรือเกี่ยวกับคณิตศาสตร์ในแง่ของสัญลักษณ์และข้อความ ดังนั้น หากไม่ได้รับการแปลแล้ว มันจะเป็นเพียงแค่การที่นักศึกษาสามารถแก้โจทย์ได้อย่างถูกต้อง ด้วยเหตุนี้ การวิจัยนี้ได้จัดทำขึ้นเพื่อระบุอุปสรรคต่างๆที่พบ และระดับความสามารถในการแปลข้อความทางพีชคณิตไปเป็นสำนวนทางพีชคณิตของนักศึกษาชั้นปีที่ 3 ของวิทยาลัยการบินประเทศฟิลิปปินส์ทั้ง 4 วิทยาเขต การวิจัยเชิงปริมาณเชิงบรรยายนี้ใช้แบบสอบถามที่ผู้วิจัยสร้างขึ้นซึ่งประกอบด้วยการทดสอบการแก้ปัญหา 20 รายการ ซึ่งเกี่ยวข้องกับการปฏิบัติการขั้นพื้นฐาน 4 ขั้นของคณิตศาสตร์ที่ได้รับในช่วงต้นภาคการศึกษาที่ 1 ปี 2559-2560 คะแนนในการทดสอบนี้วัดระดับประสิทธิภาพในการแปลข้อความในขณะที่การตีความหมายข้อผิดพลาดของนักศึกษาระบุถึงอุปสรรคในการแปลข้อความต่างๆ ผลการวิจัยระบุว่าผู้ทำแบบทดสอบมีประสิทธิภาพในการแปลข้อความต่ำกว่าระดับความพึงพอใจ ความไม่ใส่ใจ การขาดความเข้าใจ ค่านิยมการสับเปลี่ยนระหว่างคำ และคำที่ไม่คุ้นเคย เป็นอุปสรรคที่พบบ่อยในการแปลโจทย์ของผู้ทำแบบทดสอบ


**คำสำคัญ** : อุปสรรคทางคณิตศาสตร์ ; ทักษะการแก้ปัญหา ; การแปลข้อความไปเป็นสัญลักษณ์ทางคณิตศาสตร์ ระดับความสามารถ

## Introduction

Word problems have been considered as one of the topics in algebra which most of the students are afraid of. The hardest thing about doing word problems is taking the English words and translating them into mathematics. Usually, once you get the math equation, you are fine. The actual math involved is often fairly simple, but figuring out the actual equation can seem nearly impossible.

Part and parcel of word problems is to translate it into a mathematical sentence to fully understand the problem. However, student especially in 3rd year college have challenges and difficulties in analyzing and interpreting word problems. They can easily perform an indicated operation but when this is given in verbal forms, but they need to first identify what operation is involved by translating this into a mathematical sentence before actually perform the operation and arriving at the correct answer. The difficulty lies in the translation between English and mathematics and vice versa

because mathematics is such a dense language, every symbol matters; most students are not accustomed to reading that carefully. In addition, many students do not have a solid grasp of the meaning of the symbols in the first place, let alone sufficient fluency to allow for translation. While they can often solve a problem conceptually, they still struggle with symbolically representing the same problem, which leads to difficulties when they are faced with problems they cannot solve by simple reasoning.

Higher Education Institutions ensure that education is delivered through the inner nerve of students to let them work with degree of excellence domestically and internationally to produce quality graduates who are globally competitive. The aim of colleges and universities is to create, invent, and innovate instructional methods and strategies to achieve it. Instruction, research and production are focused to highest degree for students to be given proper education they deserve.

The Philippine State College of Aeronautics is one of the higher education institution offering technical courses such as Aircraft Maintenance Technology, Aeronautical Engineering, and Aviation Electronics Technology. It has four campuses: Villamor Campus located at Piccio Garden, Villamor, Pasay City; Mactan Campus located at Mactan Benito Ebuen Air Base, Lau-Lapu City; Pampanga Campus located at Palmayo, Pampanga; and Lipa Campus located Lipa City, Batangas. The highly technical nature of these courses needs methods and strategies in conducting lecture classes so that education may be effective to students. Each course has mathematics such as College Algebra, Trigonometry, Analytic Geometry, Differential Calculus, Integral Calculus and the like.

Most of the topics are not just in mathematics subjects of the above-mentioned courses involved worded statements in relation to the aviation that require the student to calculate areas and do basic unit conversions from feet to inches, solving altitudes, inclinations, fuels and other problems which also require mathematical skills for the students to be able to solve such problems. Applications of such skills are very important and it is where the College Algebra supposed to learn such skills as this is the fundamental subject that tackles translation of worded statements into mathematical symbols. It is also important to understand the topic and be able to fully grasp how aviation industry really works.

Thus, this study addressed the difficulties encountered and the performance level of the 3rd year Aircraft Maintenance Technology students of the four campuses

of the Philippine State College of Aeronautics Mactan Campus for the 1st Semester 2016-2017 in translating worded statements into mathematical symbols.

## Review of Related Studies

This study was anchored on the different problem solving heuristics of the following studies:

According to Polya (1957), solving problem is a practical skill. Students will understand problems when they observe and imitate what other people do when solving problems. Our conception of the problem differs when we are shifting points of view in the problem. Krulik & Rudnick (1996), on their book about teaching reasoning and problem solving, found that the ability of students to recognize words is fundamental to reading. Being able to visualize the problem can lead to a successful problem solving.

According to Mayer (1989, as cited in Yared, 2003), one common problem in translating sentences into symbolic language is that individuals end up remembering materials that are consistent only with their prior schemas. Bardillion Jr. cited in Yard (2003) indicates that the ability to mathematize expression is the most directly linked with success in problem solving.

Yeo (2009) found that some students have slow progress in solving the problem due to their inability to translate the problem into a mathematical form. Some students also have difficulties in solving the problem because they do not comprehend the problem as they found the problem confusing.

In the study conducted by Aniano (2010), the level of difficulties in translating phrases to symbols was one of the factors that determine the problem solving skills of students. It was seconded by Vista (2010) that students' comprehension in translating phrases into symbols affects the students' performance in problem solving.

Yared (2003), on the other hand, cited in Mayer (1982, 1989) and Matlin (1992) shows that problem solver ends up to simplifying problems even to the extent of misrepresenting the information given.

## Research Objectives

This study aimed to determine the performance level and difficulties encountered by the 3rd year Aircraft Maintenance Technology students of the four campuses of the Philippine State College of Aeronautics Mactan Campus for the 1st Semester 2016-2017 in translating worded statements into mathematical symbols.

Specifically, this study sought to answer the following questions:

1. What is the level of performance of the AMT students in translating worded statements into mathematical symbols?
2. What is the difficulty of the AMT students in translating worded statements into mathematical symbols in terms of :
   - 2.1 Misinterpretation of the Statements;
   - 2.2 Lack of Comprehension;
   - 2.3 Incorrect Use of Symbols;
   - 2.4 Carelessness; and
   - 2.5 Interchanging values
3. Base on the findings, what recommendations could be proposed to enhance the performance of the AMT students in translating worded statements into mathematical symbols.

## Research Methodology

**3.1 Design**

This study used both qualitative and quantitative methods to sufficiently describe and interpret data and information about the performance level and difficulties encountered by the 3rd year students of the four campuses of Philippine State College of Aeronautics in translating worded statements into mathematical symbols.

**3.2 Samples**

The 200 3rd year Aircraft Maintenance Technology students of Philippine State College of Aeronautics of the four campuses were chosen as respondents. There were 50 students selected in each campus who were heterogeneous.

This study was conducted at the Philippine State College of Aeronautics where the researchers are employed.

**3.3 Instrument**

The data of the study was obtained through a researchers-made test. The test was consisting of twenty items involving fundamental operations in which every operation consisted of five items. A table of specification was also used to ensure that the number of items was equally distributed. Each item was given a weight of one point. This researchers-made test will measure the performance level of the AMT Students in translating worded statements into mathematical symbols. The students were required to translate the worded problems into mathematical symbols. It was face and content validated by Institute of Engineering Technology Course Coordinator, Academic Supervisor, Campus Director and two Mathematics experienced instructors.

To avoid inconsistency in measuring the answers of the students, inter-rater reliability was used. Three inter-raters were tasked to check and re-check each item answered by each student correctly. Each rater went through the items and determined whether they were correctly translated or not into mathematical symbols. Miles & Huberman's (1994) formula was used as a statistical measure of inter-rater agreement were the formula is:

$$\text{Reliability} = \frac{\text{Agreement}}{(\text{Agreement}+\text{Disagreement})} \times 100$$

**3.4 Data Collection**

The researchers requested for permission from the participating campuses' Directors. The researcher-made test was distributed at the time when students have already covered addition, subtraction, multiplication and division of algebraic expressions during the preliminary period of the 1st Semester 2016-2017.

The test was administered by the researchers themselves. Students were instructed to write the mathematical symbol of each worded statement in the questionnaire. They were tasked to determine which operation that could best be performed to translate the worded statements. Students were given 45 minutes to answer the entire questionnaire.

**3.5 Data Analysis**

The researchers adopted norms for interpretation from the school's standards of the participating campuses to answer the performance level of translating worded statements into mathematics symbols of the 3rd Year AMT students.

Table 1 shows the norms for interpretation adopted from the campus standards.

***Table 1*** *Norms of Interpretation*

| Score | Description |
|---|---|
| 18-20 | Outstanding |
| 14-17 | Very Satisfactory |
| 10-13 | Satisfactory |
| 6-9 | Poor |
| 0-5 | Very Poor |

Such is the participating campuses grading system where the base score is equivalent to 70%.

The common mistakes respondents had in each item were determined and interpreted to determine students' difficulties in their translation. The following difficulty categories "misinterpretation of the problem" and "lack of comprehension of the problem posed" were adopted from the work of Yeo (2009). Other difficulties which the researcher deemed not falling under Yeo's framework were also documented and analyzed, such as the use of incorrect operations, carelessness, and inter-changings values.

## Research Results and Discussions

Student's Performance in Translating Worded Problems

Fig. 1 shows the AMT student's scores in translating worded statements into mathematical symbols. It appears that 6 out of 200 AMT students got a perfect score while 7 out of 200 got a score of 0 in the test. It shows in the graph that the distribution of scores is inconsistent since the bars vary in height.

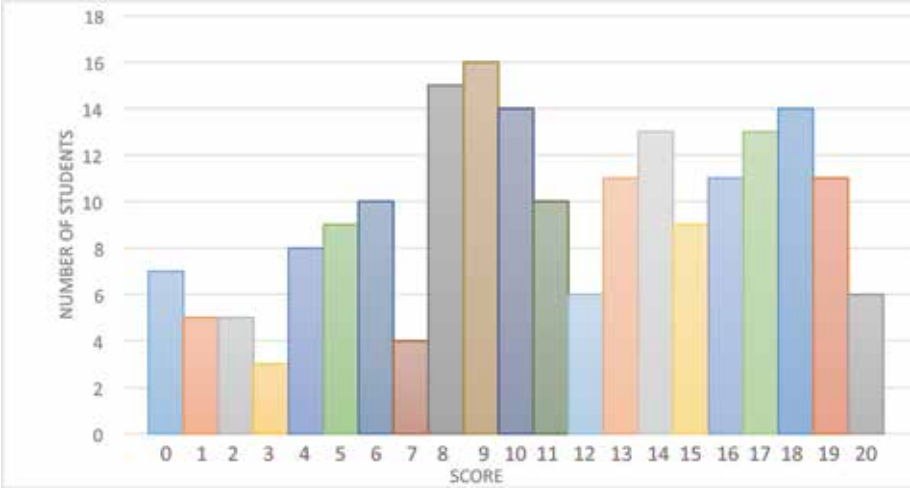


Fig.1. Scores in translating worded statements into mathematical symbols

It was found out in Fig. 2 that 16% of the respondents have outstanding performance level in translating worded statements to mathematical symbols. On the other hand40% of the respondents are below the satisfactory level of performance in translating worded statements to mathematics symbols in which 18% belongs to very poor performance and 22% described as poor,

In general, 60% of the AMT students meet the satisfying score in translating worded statements to mathematical symbols.


Fig. 2 Level of performance in translating worded statements.

2. Student's Difficulties in Translating Worded Statements

Below are scanned works of students showing difficulties in translating worded statements into mathematical symbols. All AMT students' answers were analyzed and were carefully chosen to represent other similar solutions.

From Yeo (2009)

1. Misinterpretation of the Problem

AMT Students failed to translate the problem due to misinterpretation. According to Yeo (2009), students misinterpret the problem when they reflect solutions that are opposite or contrary to the correct solution.

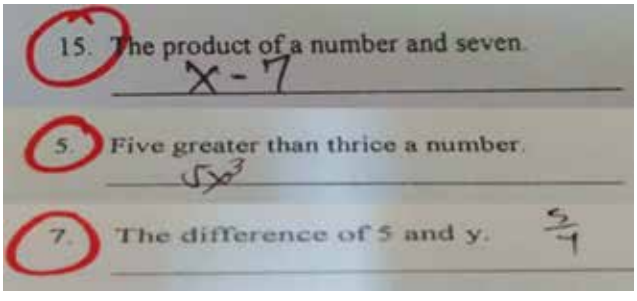


Fig. 3. Answers showing misinterpretation of the statements

About 120 out of 200 students, who answered item number 1 incorrectly, misinterpreted the statement. In figure 3, the students answered item number 15 as "x - 7" when it should be "7x". Students translated the phrase "product" as difference instead of multiplication. While in item number 5, where 110 out of 200 students misinterpreted the statement. Students thought that the phrase "greater than" refers to multiplication instead of addition.

On the other hand, one student thought that "difference" in item number 7 refers to division instead of subtraction. This happened to 82 out of 200 students who got an incorrect answer in this item. Students looked for keywords when they read a statements instead of trying to understand what the statement is all about and this had lead them into a wrong translation of the worded statements into mathematical symbols.

## 2. Lack of Comprehension

Fig. 4 shows the incorrect answers of students who did not comprehend fully the statements. They got difficulties encountered in translating worded statements as "they were unable to visualize and did not comprehend the problem at all"Yeo (2009).

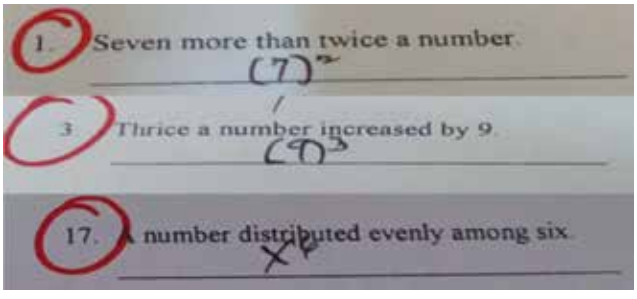


Fig. 4. Answers showing students did not fully comprehend the statement

In Fig. 4, a student answered item number 14 by just writing the given value in the order as they appear in the statement and just guessed the fundamental operation. This happened to the students who answered item number 15 as "7x^2" when it should be "2x + 7". Same happened with different students who answered item numbers 3 and 17.

These categories are formed aside from those of Yeo's.

## 3. Incorrect use of Operations

It appears in Table 2 that division is the fundamental operation most 3rd year AMT students have difficulty with. This consists of 149 students, which is 74.5% of the sample population. Division was seconded by Multiplication in which 48% got mistakes.

***Table 2*** *Mean of Incorrect Answer*

| Operation | Mean number of students | Percentage |
|---|---|---|
| Addition | 46.2≈48 | 23% |
| Subtraction | 79.2≈ 79 | 39.5% |
| Multiplication | 95.6≈ 96 | 48% |
| Division | 148.6≈ 149 | 74.5% |

The mean of incorrect answers was determined by getting the mean score of correct answers in each of the four fundamental operations. Since there are five questions for each operation, the researchers tallied those students who got correct answer in each question then added the total number of correct answers to the other items with the same operation and divided by five. Since there are 200 respondents in the study, the researchers subtracted the mean score of correct answers from the total number of the respondents.

## 4. Carelessness

Eighteen out of 61 students who got an incorrect answer in item number 10 made careless mistakes. In the figure shown above, a student answered the number 2 item carelessly, student got the correct expressions but failed to correctly answered the operation instead of "+", the student mistakenly answered "-". On the other hand, for item number 16, the student got the correct arithmetic operation which is division but answered "c" instead of "x". The same is reflected in item number 3, instead of "3x + 9", the student mistakenly wrote "x + 9".

Fig. 5 shows that some students who made mistakes knew the operation but tended to miss out, added value or wrote a different value because of carelessness. In all items, few students made careless mistakes.

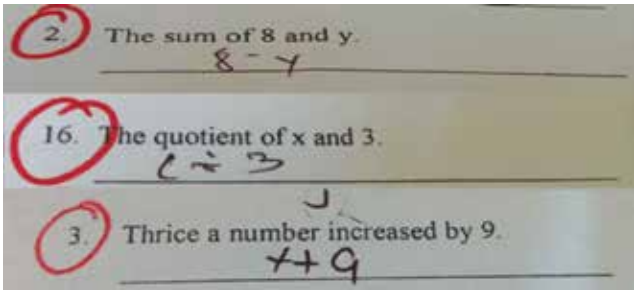


Fig. 5. Answers showing careless mistakes.

## 5. Interchanging Values

Interchanging values mostly occur in items involving subtraction and division in which students interchange value for minuend in subtrahend, and vice versa. The

same goes for division in which the divisor is incorrectly placed as the dividend and vice versa. This incorrect translation into mathematical symbols will eventually lead to incorrectly solving the given as unlike addition and multiplication, subtraction and division are not commutative operations.

In Fig. 6, for item number 8, the minuend "5x" was written as subtrahend and vice versa in item number 10. Eighty two (82) out of 200 students interchanged these values in item number 8.

On the other hand, in item number 16 where about 15 out of 200 AMT students interchanged the values x and 3 as divisors and dividends, respectively. These are the same answers given by students who tend to write the values in accordance to the position of the value stated in the given which lead them to translate worded statements into mathematical symbols incorrectly. It is also considered as one of the difficulties encountered in translating worded statements into mathematical symbols.

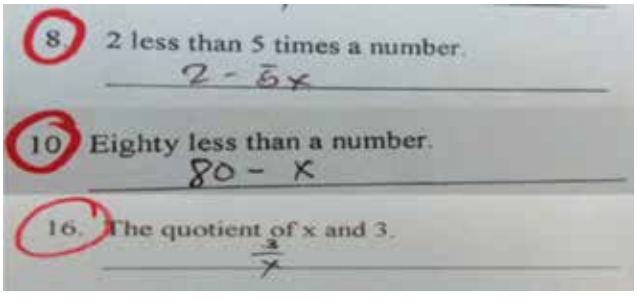


Fig. 6. Answers showing interchanging values of the given statements.

## 6. Conclusions

In the light of the findings, it is therefore concluded that the students' ability in translating worded statements into mathematical symbols depends on how they comprehend the given statements through analysis and application of knowledge. Students must comprehend the given statements before answering because translating worded statements is a difficult task as it involves presence of mind and knowledge on how to apply the basic mathematical operations.

The regular learning target of at least 85% of the AMT students must be able to translate worded statements into mathematical symbols was not met as only 60% of the AMT students was in and above the satisfactory level of performance.

Of the four operations, students had division as the most difficult to perform. This may be because division is the operation less prioritized in every discussion involving whole number or decimals. This is the last operation taken up in their classes. So, instructors may have made the least focus on this topic.

## 7. Recommendations

The following recommendations are herein proposed:

7.1 The College may consider sending instructors to different trainings and seminars related to mathematics to enhance their strategies in teaching.

7.2 The College may consider sending instructors abroad for further studies.

7.3 The College may consider giving financial benefits to those faculties who performed well.

7.4 Instructors may consider having a manual or workbook to enhance the students mathematical skills.

7.5 Instructors may consider varying their teaching strategies to suit to students different levels of comprehension.

7.6 Instructors may incorporate worded statement activities into daily instruction, instead of saving them for independent seatwork or homework. They should consider students unit goals and students' background and interests when preparing worded statement activities.

7.7 Instructors may focus on specific ways to teach worded statements like covering instruction in visual representations, such as tables, graphs, and diagrams. Well-chosen visual representations help students focus on what is central to many mathematical statements.

7.8 Instructors are encouraged to teach multiple strategies that can be used during class. Sharing, comparing, and discussing strategies afford students the opportunity to communicate their thinking and, by listening to others, become increasingly flexible in the way they approach and translate statements. Too often students become wedded to just one approach and then flounder when it does not work on a different or more challenging problem.

7.9 Instructors are encouraged also to help students recognize and articulate mathematical concepts and notation during translation of worded statement activities. The key here is for instructors to remember that students' skills will improve when students understand the formal mathematics at the heart of each statement.

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