

Linguistics Variables Germane to the Proficiency of Intermediate Pupils in Mathematics: An Input for Primer Conceptualization

MICHAEL L. ESTREMER, MAED + 60 units Ph.D.
Marinas 1 Elementary School, Sorsogon East, Sorsogon City 4700, Philippines

Abstract

There have been researches which delineated the high correlations between Mathematics achievement and reading ability. The ability to read Mathematics in a second language has been obviously influenced by a variety of language skills. This academic pursuit delved on the linguistics factors germane to the proficiency of intermediate pupils. A primer was developed by the researcher with great considerations on the results of the study. Findings reveal that intermediate pupils have fair proficiency level due to the identified linguistics factors (dependent variables) such as complexity of words, vocabulary level, verbal cues, linguistics distractors and linguistics schema deemed as the chief contributory variables. Moreover, sentence order, connecting words, semantic relations, and lexical terms are supplementary dependent variables (DV) attributed to the fair proficiency of the intermediate pupils in Marinas Elementary School which a frequency of five (5 or approximately 83% of the teacher respondents and ranked the second among the identified linguistics variables. The researcher recommends the ff.: (1) Reproduction of the conceptualized primer in Mathematics be done to partially solve the issues on instructional material scarcity. (2) Submission of the copyrighted instructional material be furnished the Library Hub of the City Division of Sorsogon for future reference; and (3) Trainings on instructional material development be conducted not just in Mathematics but also to other subjects.

Keywords: Linguistics Variables, Germane, Proficiency Level, Intermediate Pupils, Conceptualization

I. Introduction

Pursuant to Section 16 of Republic Act No. 10533, entitled “An Act Enhancing the Philippine Basic Education System by Strengthening Its Curriculum and Increasing the Number of Years for Basic Education, Appropriating Funds therefor and for Other Purposes,” otherwise known as the “Enhanced Basic Education Act of 2013,” Hence, the Department of Education (DepEd), the Commission on Higher Education (CHED), and the Technical Education and Skills Development Authority (TESDA) issued rules and regulations to implement the provisions of the Act.

Furthermore, Ono [1] emphasized that reading has the potential to help English language learners become better readers and make improvements in other aspects of their English skills. The importance of reading comprehension is emphasized in the education community; however, everyone may not realize how important reading actually is. Although strong reading skills can help students do well in language arts and reading class, that is only the beginning. Students have to use reading skills in every single subject they ever study and in almost every aspect of life. It is so sad to note that students who struggle with reading comprehension may fall so far behind in school that they have limited opportunities as an adult.

A student, who can read comprehensively, is likely to be successful in all his or her lessons. In Mathematics lesson, when a learner encounters with a problem, understanding this problem can help him/her to solve the problem. It is known that in the Philippines, the university and high school entrance examinations have mostly questions based on testing learners' ability whether they can read comprehensively and can come up with new interpretations by making analysis and synthesis on the given data in the many research tasks.

To this effect, based on the pretest results of Grade 6 in Mathematics conducted by the researcher, there have been noted very low performance and proficiency levels. The pre-requisite skills seemingly were not developed most specially in solving word problems. In the daily conduct of lessons of the researcher, however, there are obvious problems on linguistic competence which hinder them to arrive at the exact answer. The motivation of students toward studies aggravates the situation. Absenteeism and pessimism of students are also present during delivery of lessons.

These facts motivated the researcher to conduct a study focusing on intermediate pupils along Mathematics subject in Marinas Elementary School. It eventually will benefit much the students as they use the instructional material developed by the researcher.

II. Review of Related Literature Studies

To anchor this present study, the researcher considered local and foreign literatures and studies along Mathematics and Linguistics to provide a compressive picture of what practically this research is all about. However, the most related ones are only included.

Instructional materials are aids in the learning process such as pictures, charts, big books, reading modules, concrete objects even the use of multi-media to make teaching practically meaningful and real (Stariba) [2]. In

the study of (Mendoza) [3], this refers to the teaching aid she used to improve and determine the reading level of the Grade V & VI multigrade pupils in Barcelona District, Province of Sorsogon. The reading level includes literal, interpretive, critical and applied level of reading.

Studies on the relation between linguistic structure and student performance on WPs have considered complexity at the micro-level of word and sentence forms as well as at the macro-level of the discourse structure of the WP passage. Early approaches addressed structural complexity in terms of basic quantitative properties of the WP text, such as the number of letters, words, sentences, mean word, and sentence length, or the proportion of complex (long) words (Searle et al.) [4].

More linguistically motivated variables have been investigated in the context of comprehension difficulties in WPs for language learners, for the most part learners of English. At the vocabulary level, comprehension difficulties which result in problem solving difficulties for English language learners may stem from the presence of unfamiliar (low-frequency) words, polysemous words, idiomatic or culturally specific lexical references. At the sentence structure level, factors that have been shown to play a role include noun phrase length, the number of prepositional phrases and participial modifiers, the presence of passive voice and complex clause structure such as relative, subordinate, complement, adverbial, or conditional clauses (Spanos et al.) [5].

A single factor that is straightforwardly related to WP difficulty and that has been widely investigated is the presence or absence of explicit verbal cues whose semantics hint at the expected operation and thus directly lead toward the solution. Verbal cues include words and phrases of different categories: conjunctions (“and” for addition), adverbs (“left,” “more than,” “less than” for subtraction), or determiners (“each” for multiplication). Eye tracking studies have shown that subjects tend to focus on linguistic verbal cues and perform translation directly to the mathematical operation (Hegarty et al.) [6].

Because verbal cues so often lead to default mathematical interpretation (Nesher) [7], even small differences in phrasing in cue words can cause significant changes in performance. This is especially relevant for young children (Lean et al.) [8], who in the course of development connect words such as “join,” “add,” “get,” “find,” or “take away” with concepts such as *putting together*, *separating*, *giving away*, or *losing*. A problem can thus be reworded by adding verbal clues which make the semantic relations more salient so that the underlying mathematical relation is more explicit. For example, the WP “There are five marbles. Two of them belong to Mary. How many belong to John?” can be reworded as “There are five marbles. Two of them belong to Mary. The rest belong to John. How many belong to John?” (Cummins) [9]. This kind of conceptual rewording has been shown to be useful to improve children’s performance on WPs (Vicente et al.) [10]. Thus changes in wording can influence representation (De Corte et al.) [11].

Interestingly, an effect related to information load has been observed; the presence of content irrelevant to the core solution, i.e., the presence of numerical or linguistic distractors, results in higher error rates (Muth) [12]. De Corte and Verschaffel [13] found that the semantic structure of WPs influences children’s choice of mathematical solution strategy. In terms of the broader task context, the required or expected way of responding to the WP has a big influence, especially for the domain of multiplication and division with rational numbers as argued in De Corte et al. [14]; for example, whether students are expected to answer the problem numerically or if they only have to indicate the required operation, or whether they respond in an open way or with multiple choice.

Word problems require some connection between linguistic and mathematical understanding by the very nature of the task, because at least children do not have a repertoire of “highly automatized schemata” for representing the different problem types (Garcia et al.) [15]. Therefore, it is not surprising that children make more errors when solving WPs compared to number problems (Geary) [16]. Children are able to solve several types of addition and subtraction problems before they start formal schooling (Lean et al.) [8], and understand numerical concepts before seeing WPs in their curricula (Garcia et al.) [15].

Therefore, most studies implicitly assume that problem solvers always have the necessary basic arithmetic skills, even in the case of children. This may lead to the misconception that numbers may play a lesser role than they actually do and factors other than computational skills are a major source of difficulty with WPs (Nesher) [7]. In this aspect, it is also important to note that difficulties in solving WPs have been reported that could be neither attributed to the lack of general reading comprehension skills nor to the lack of general mathematical skills (Hegarty et al.) [17].

III. Research Objectives

This basic research probed the proficiency level of Grade 4, 5, & 6 intermediate pupils in Marinas Elementary School for S.Y. 2017-2018, and linguistic variables affecting their academic performance.

Specifically, it rolled-out answers to the questions hereunder stated:

1. What is the proficiency level of intermediate pupils in Mathematics as affected by linguistics variables based on first and second quarter examinations?
2. What are the linguistic variables that affect the proficiency of intermediate pupils in Mathematics as identified

by their teachers?

3. What instructional material may be conceptualized based on results of the study?

IV. Scope and Limitations

This academic pursuit was conducted in Marinas Elementary School for S.Y. 2017-2018. It is confined at probing answers relative to the proficiency level of intermediate pupils and linguistic variables affecting their academic performance based on first and second quarter examinations. The respondents are the intermediate Mathematics teachers handling the subject. Other grade level Mathematics teachers are deemed excluded in this quest for answer.

Thus, the present study is limited only at providing answers on proficiency level and linguistics barriers. Other concerns and issues not within the ambit of this endeavor had been considered unrelated to this pursuit.

V. Methodology

The descriptive-developmental method of research was utilized in this quest for answer. It is considered as a descriptive study insofar as, in the process, it delineated the proficiency level of intermediate students and linguistic factors affecting their academic performance based on first and second quarter examinations through a researcher-made questionnaire. These quarters are chosen since the study falls under the said period. Also, it is considered developmental to the extent that an instructional material was developed by the researcher based on the findings of the study. An observation was likewise done to the subjects of the study upon distribution of questionnaire to enrich this piece of work. Unstructured interview to the respondents enhanced this pursuit for excellence in the field of education.

A. The Sampling

The primary sources of data are the intermediate or the Grade 4, 5, and 6 teachers teaching Mathematics in the subject school chosen purposively. Campollo [18] delineates purposive sampling as determining the target population, those to be involved in the study. The respondents are chosen on the bases of their knowledge and of the information desired. The researcher, for the most part, considered purposive sampling to ensure high validity gauge of the pursuit. Besides, the hereunder chosen respondents are the ones in close monitoring of the intermediate pupils, assessing students' output and determining the students' proficiency level.

Table I
Distribution of the Respondents

<i>SCHOOL</i>	<i>GRADE LEVEL</i>	<i>No. of Teacher Respondents</i>	<i>No. of Pupils</i>
Marinas 1 Elementary School	4	1	23
	5	1	23
	6	1	18
Marinas 2 Elementary School	4	1	17
	5	1	11
	6	1	14
		$\Sigma = 6$	106

B. The Instrument

The main instrument employed by the researcher is a questionnaire. It primarily included the profile of the respondents or personal data, the table to determine the proficiency level and a checklist to find out the linguistic variables that affect the academic performance of intermediate students. However, prior to the questionnaire distribution, the instrument was subjected to editing and checking by the two (2) school heads in the subject schools to ensure validity and reliability of the instrument.

C. Ethical Issues

This action research was undertaken in response to the DepEd's call for research intensification and also systematically finding answers to the challenges encountered by teachers relative to the implementation of K to 12 curriculum and is not categorically divulging the incompetence of the respondents or the low academic performance of pupils featured in this masterpiece. In the process of research, the data and information that were taken from the respondents had been held with utmost confidentiality and anonymity. Ensuing research ethics and rules had also been aptly observed by the researcher to circumvent future problems relative to plagiarism, intellectual dishonesty and the like. Cited researchers and authors can be verified as highlighted in the succeeding pages.

D. Plan for Data Analysis

The quantitative method of analyzing data was utilized in this research. This involves frequency, mean, rank, and percentage to determine the most common answers to the foregoing questions. As for De Belen [19], this research design or paradigm needs to be based or built upon past research. It has to review prior research to

formulate its research method. It indicates the degree of intervention, the nature of any comparisons, the methods used to control extraneous variables, and the timing and location of data collection. Moreover, to determine the proficiency level of the intermediate pupils, the researcher – devised scale delineated below shall be aptly utilized:

CLASS PERFORMANCE LEVEL	→	DESCRIPTION
90-100	→	<i>Excellent Proficiency Level</i>
80-89	→	<i>Very Satisfactory Proficiency Level</i>
70-79	→	<i>Satisfactory Proficiency Level</i>
60-69	→	<i>Fair Proficiency Level</i>
0-59	→	<i>Poor Proficiency Level</i>

Tabular presentations are also necessary to accurately show the outcome of this piece of work. Moreover, related literatures and studies may be used to support the findings of the research.

VI. Results and Discussion

The table II.A highlights the proficiency level of intermediate pupils based on the first quarter examinations administered by their respective Mathematics teachers. The respondents constructed their own tests for the specified quarter with variance noticeably on the number of items depending upon the grade level being handled. For grade four pupils, it usually consists of a 40-item test, 45 for grade five pupils and 50 items for grade six.

For Marinas I Elementary School, grade four pupils gleaned a class mean score of 23.55 with 58.88 performance level and fell under the *fair proficiency level*. The grade five pupils earned mean score of 27.75 out of a 45 – item test. This yielded a performance level of 61.67 categorized under *fair proficiency level*. In the same vein, it is obvious in the above table that grade six pupils also were considered as *fairly proficient* with 59.90 performance level.

In the like manner, delineated also in the above table is the proficiency level of Marinas II Elementary School intermediate pupils. The grade five pupils earned the highest performance level of 65.09, seconded by the grade six pupils that obtained a mean score of 32 and performance level of 64, while the grade four class garnered the least performance level of 60.7. These fall under fair proficiency level with an SD measurement of 7.79.

In the same vein, the mean performance level of 67.71 and descriptive level of *fair proficiency* would presuppose that there have been extant likewise germane linguistics variables attributed to the low proficiency level of the intermediate pupils. This is confirmed during the unstructured interview conducted by the researcher upon distribution and retrieval of the questionnaires.

Table II.A
Proficiency Level Based on First Quarter Examinations
S.Y. 2017-2018

SCHOOL	GRADE LEVEL	No. of Students	No. of Items	MEAN SCORE	PERFORMANCE LEVEL	Standard Deviation	Descriptive Level
Marinas 1 Elementary School	4	23	40	23.55	58.88	7.67	Fair Proficiency
Marinas 1 Elementary School	5	23	45	27.75	61.67	7.85	Fair Proficiency
Marinas 1 Elementary School	6	18	50	29.95	59.90	7.74	Fair Proficiency
Marinas 2 Elementary School	4	11	40	24.28	60.7	7.79	Fair Proficiency
Marinas 2 Elementary School	5	17	45	29.29	65.09	8.07	Fair Proficiency
Marinas 2 Elementary School	6	14	50	32	64	8	Fair Proficiency
		$\Sigma = 106$	$\Sigma/n = 45$	27.80	61.71	7.85	Fair Proficiency

In fact, the respondents bluntly deplored the implementation of Mother Tongue Based- Multilingual Education (MTB - MLE) in the primary grades as the chief contributory factor to the performance of their pupils based on the first and second quarter examinations. Pupils have limited exposures to English language hence comprehension level is directly affected specially on solving word problems (WP) which require thorough analysis and linguistics ability.

This claim is associated to the idea of (Spanos et al.,) [5] who underscored that more linguistically motivated variables have been investigated in the context of comprehension difficulties in WPs for language learners, for the most part learners of English. At the vocabulary level, comprehension difficulties which result in problem solving difficulties for English language learners may stem from the presence of unfamiliar (low-frequency) words, polysemous words, idiomatic or culturally specific lexical references.

At the sentence structure level, factors that have been shown to play a role include noun phrase length, the number of prepositional phrases and participial modifiers, the presence of passive voice and complex clause structure such as relative, subordinate, complement, adverbial, or conditional clauses.

Similarly, researchers have found high positive correlations (.40 to .86) between mathematics achievement and reading ability (see Aiken, [20] for a review of this research). The ability to read mathematics in a second

language is obviously influenced by a variety of language skills. Cossio [21] found a positive correlation between mathematics achievement and second language ability. In addition, there appears to be a direct relationship across various school subjects between instruction in the student's native language and high achievement in the subject (Coffland & Cuevas [22] Cuevas & Llabre [23], and Granado [24]).

Table II.B
Proficiency Level Based on Second Quarter Examinations
S.Y. 2017-2018

SCHOOL	GRADE LEVEL	No. of Students	No. of Items	MEAN SCORE	PERFORMANCE LEVEL	Standard Deviation	Descriptive Level
Marinas 1 Elementary School	4	23	40	27.04	67.60	8.22	Fair Proficiency
	5	23	45	22.29	49.53	7.72	Fair Proficiency
	6	18	50	29	58	7.62	Fair Proficiency
Marinas 2 Elementary School	4	11	40	28.05	70.13	8.37	Satisfactory Proficiency
	5	17	45	21.29	47.31	6.88	Fair Proficiency
	6	14	50	26	52	7.21	Fair Proficiency
		$\Sigma = 106$	$\Sigma/n = 45$	25.61	57.43	7.67	Fair Proficiency

Table II.B rolls-out data and information anent the proficiency level of intermediate pupils based second quarter examinations as conducted by the respondents. Intermediate pupils in Marinas I Elementary School are sixty (60) thereabouts, as of date of the conduct of study for S.Y. 2017- 2018. There are three Mathematics intermediate teachers yielding a teacher to pupil ratio of 1:20. Teachers constructed test questions taking into consideration the Curriculum Guide issued by the Department of Education with specified quarters and underlying competencies to be finished within a quarter.

As presented, grade four pupils in Marinas I gleaned a mean score of 27.04 out of a 40-item with 67.6 performance level deemed categorically based on the researcher –made scale as *fairly proficient*. As for grade five pupils, they obtained 22.29 mean score and 49.53 performance level under *fair proficiency level*. Furthermore, the grade six pupils accumulated a mean score of 29 out of a 50-item test during the second quarter. Expectedly, their performance level of 58 is classified under *fair proficiency*. Conversely, it is notable in the foregoing table that out of a 40-item test for grade four pupils, it yielded a mean score of 28.05 having a performance level of 70.13 considered as *satisfactorily proficient*. This is the only grade that was able to bridge to the *satisfactory level* insofar as the first and second quarter examinations are concerned. However, this turnout would still denote that there are linguistics variables relevant to the proficiency level of the grade four pupils in Marinas II. This, for the most part, has a long way to go as far as *excellent proficiency* is concerned which is roughly 29.87 to make it to the *excellent level* taking into account the proficiency scale of the study. Meanwhile, the grade five and six pupils earned a performance level of 47.31, 52 respectively interpreted as *fairly proficient*.

In the long run, the summation of 57.43 under performance level depicts a low proficiency level of the intermediate pupils in Marinas II. During the unstructured interview conducted by the researcher, it was underscored that there could in effect be linguistics factors relevant to the proficiency level of the pupils at large. The respondents pointed fingers *en masse* to the instructional material inadequacy and language immersion of the subjects of the study.

This is germane to the view of Gaarder [25] who argued that the use of English as the language of the test is one reason for the low achievement scores of Hispanic students. Several studies have lent support to this hypothesis. Holland [26], Meeker and Meeker [27], and Mycue [28] found that when tests were translated, Hispanic students tended to do better on the Spanish version than on the English version. Anastasi and Cordoa [29] and Manuel and Wright [30], however, found no difference in performance on the Spanish and English versions of achievement tests. A factor not sufficiently controlled in some of these studies is the students' relative proficiency in their first and second languages.

Notably, some researchers Oller & Perkins, [31] have suggested that intelligence, achievement, and personality instruments basically test language proficiency. They present the results of various factor analytic studies in support of their claim. Given the inevitable dependence of achievement and intelligence tests on language, it follows that such tests are likely to have decreased reliability and validity for students with a limited proficiency in English. Llabre and Cuevas [32], for example, found that, for students whose first language was Spanish, scores from mathematics achievements tests (on concepts, and applications) were less reliable than is generally considered acceptable in the literature. Llabre and Cuevas [33] recommend that the primary language of instruction, the student's level of reading proficiency in that language, and the skill being measured should all be taken into account when interpreting the score of a student from a language minority on a mathematics achievement test.

Revealed in Table III are the linguistics variables relevant to the proficiency of the intermediate pupils based on the first and second quarter examinations. The specific competencies from grades four to six as affected by the linguistics factors are also emphasized. Hence, the *independent variables (IV)* represent most likely the

length, the number of prepositional phrases and participial modifiers, the presence of passive voice and complex clause structure such as relative, subordinate, complement, adverbial, or conditional clauses.

A single factor that is straightforwardly related to WP difficulty and that has been widely investigated is the presence or absence of explicit verbal cues whose semantics hint at the expected operation and thus directly lead toward the solution. Verbal cues include words and phrases of different categories: conjunctions (“and” for addition), adverbs (“left,” “more than,” “less than” for subtraction), or determiners (“each” for multiplication). Eye tracking studies have shown that subjects tend to focus on linguistic verbal cues and perform translation directly to the mathematical operation (Hegarty et al.) [6].

Similarly, word problems require some connection between linguistic and mathematical understanding by the very nature of the task, because at least children do not have a repertoire of “highly automatized schemata” for representing the different problem types (Garcia et al.) [15]. Therefore, it is not surprising that children make more errors when solving WPs compared to number problems (Geary) [16]. Children are able to solve several types of addition and subtraction problems before they start formal schooling (Lean et al.) [8], and understand numerical concepts before seeing WPs in their curricula (Garcia et al.) [15].

VII. Conclusion and Recommendation

This part delineates the conclusions and recommendations of the researcher addressed directly to the educators, administrators, curriculum planners and research enthusiast teachers for consideration. The data and information provided herein could serve as basis in the field of language and numeracy inasmuch education is concerned.

Based on the findings of the study, the following conclusions were drawn: (1) The proficiency level of the intermediate pupils in Marinas Elementary School is generally *fairly proficient*. (2) There are linguistics variables germane to the proficiency level of the intermediate pupils. (3) A primer may be conceptualized taking into account the outcomes of the study.

Moreover, this study has been conceptualized in order to give light to the relevance of the two featured subjects which sometimes are viewed by majority as two contradicting subjects. Mathematics and English teachers handling intermediate grade levels, therefore, may consider the foregoing findings in the teaching-learning process in order for their clientele to be linguistically and mathematically inclined. School administrators and faculty members, on the other hand, shall clasp their hands together in crafting school intervention programs and projects that will cater to the needs of their end recipients such as team team-teaching of Mathematics and English teachers observing thematic instruction in the conduct of their lessons, Reading Remediation Programs, Numeracy and Literary measures and the like. This will pave the way for comprehension of the lessons insofar as selections and paragraphs made show relevance to each other. The two separate teachers too should have one goal in mind that is to establish connections to the learners thru the instructional material collaboratively done.

Hence, in the light of the findings, the following recommendations are given: (1) Reproduction of the conceptualized primer in Mathematics be done to partially if not totally solve the issues on instructional scarcity. (2) Submission of the copyrighted instructional material be furnished the Library Hub of the City Division of Sorsogon for future reference; and lastly, (3) Trainings on instructional material development be conducted not just in Mathematics but also to other subjects. This will provide room for improvement of both teachers and students to increase the proficiency level and achieve the yearned quality education which will redound to global competitiveness. (4). Parallel researches anent language and numeracy be conducted to other schools in the City Division of Sorsogon to show relatedness and enrich this academic undertaking. (5). Correlational studies utilizing parametric statistical tools is necessary to display significant relationships between linguistic variables and numeracy level of pupils.

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