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The Effect of the English Language Level of Proficiency on Mathematical Problem Solving Skills For Third-Graders at Mashrek International School in Amman

تأثير مستوى الكفاءة في اللغة الانجليزية على مهارات حل المسائل الرياضية لدى طلاب الصف الثالث في مدرسة المشرق الدولية في عمان

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Thesis submitted in partial fulfilment of the requirements for the degree of Master of English Language and Literature

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Authorization

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Dedication

This thesis is dedicated to all the people without whom this thesis would have never been written, the ones who supported me ceaselessly during my journey,

TO MY FATHER…. WHO HAS ALWAYS BEEN MY ROLE MODEL,

TO MY MOTHER…. WHO HAS BEEN WITH ME THROUGH THICK AND THIN,

TO MY HUSBAND AND DAUGHTER…. WHO HAVE BEEN A CONSTANT SOURCE OF SUPPORT AND ENCOURAGEMENT…

Table of Contents

List of appendices

The Effect of the English Language Level of Proficiency on Mathematical Problem Solving Skills For Third-Graders at Mashrek International School in Amman

By

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Abstract

This study aimed to examine the effect the students' level of proficiency in the English language had on their mathematical problem solving skills, and how the instructional design for mathematical problem solving may be altered to meet the individual students' needs. The researcher selected a purposive sample of 78 third grade students who were enrolled at Mashrek International School during the academic year 2016-2017. The researcher utilized quantitative and qualitative data to obtain the results. A mathematical problem solving test was administrated to the sample, and interviews were conducted with homeroom teachers, the program coordinator and the head of primary to obtain more information.

The findings revealed that the students' level of proficiency in the English Language, the language of instruction, directly affected the students' performance in the mathematical problem solving test. The participants in the advanced group obtained higher means and percentages of correct answers across the different categories of the mathematical problem solving test. Additionally, the results revealed that the instructional design might be altered by using different strategies including differentiation, and manipulative learning resources. It may also be altered by introducing the mathematical language to students, and ensuring that they comprehend the theorems and definitions, before embarking on the journey of worded problems solving.

Key Words: effect, English, proficiency, mathematical, word problems, international school.

تأثير مستوى الكفاءة في اللغة الانجليزية على مهارات حل المسائل الرياضية لدى طلاب الصف الثالث في مدرسة المشرق الدولية في عمان

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الملخص

هدفت هذه الدراسة الى اختبار تأثير مستوى كفاءة الطلاب باللغة الانجليزية على مهارات حل المسائل الكلامية لديهم و كيفية تعديل التصميم التعليمي ليوائم قدرات الطلاب المختلفة. ولأجل تحقيق هذه الاهداف اختار الباحث عينة قصدية تتكون من 78 طالبا من طلاب الصف الثالث المسجلين في مدرسة المشرق الدولية للعام الدراسي 2016-2017. استخدم الباحث تصميما نوعيا وكميا مختلطا، تم اخضاع العينة لاختبار في المسائل الكلامية في مادة الرياضيات و تم اجراء مقابلات مع مربيات صفوف الطلاب ومنسقة البرنامج و مديرة المرحلة الابتدائية للحصول على معلومات اضافية.

وقد كشفت الدراسة عن وجود علاقة مباشرة بين مستوى كفاءة الطلاب في اللغة الانجليزية- وهي لغة التدريس- و مهاراتهم في حل المسائل الكلامية، حيث أظهرت الدراسة ان الطلاب ذوو مستوى الكفاءة المتقدم حصلوا على اعلى معدلات و نسب اجابات صحيحة في مختلف الفئات الموجودة في اختبار المسائل الكلامية.

كما و قد أظهرت النتائج بأنه من الممكن تعديل التصميم التعليمي ليوائم احتياجات و قدرات الطلاب الفردية من خلال استخدام استراتيجيات متنوعة من اهمها: تبني سياسة التدريس التمييزي و

استخدام المحسوسات كمصدر تعليمي بالاضافة الى تمهيد المعرفة الرياضية للطلاب عن طريق التأكد من فهم الطلاب للمفاهيم و النظريات الرياضية الاساسية قبيل تعريضهم للمسائل الرياضية الكلامية.

الكلمات المفتاحية: تأثير، الكفاءة، اللغة الانجليزية، المسائل الرياضية، مدرسة دولية

Chapter One

1.1 Introduction

Language is a medium through which ideas are expressed. It is a verbal means of communication that allows the transmission of an unlimited range of subject matter. Language plays a critical role in the learning process as it allows the learner to understand a certain subject. English, as a distinctive language, has left its mark as an influential, global medium of communication. It is widely used in various countries in a variety of settings. Its prevalent use as a lingua franca led to its wide implementation in schools and other academic institutions as a means of instruction. English proficiency is an essential component of performance when used as the medium of instruction in academic settings. Mathematical learning is mediated through language. Mathematical worded problems are an example of how language is used to reign over different subject areas.

The aptitude to solve mathematical word problems is an important skill for students of all ages. This skill enables students to form a connection between what they learn inside the classroom and the real-life situations that they are bound to face. Teaching mathematics aims at helping students become critical thinkers who can apply their knowledge meaningfully in their daily lives (Halai,1998). Developing mathematical proficiency has been documented as a crucial issue for children and their education. Mathematical development which happens in the early years is extremely important for the students' success and achievement both in school and in life pursuits (Kilpatrick, Swafford, & Findell, 2001). Not only is mathematics important because of its application of basic numeracy skills, but it also functions as the main vehicle for developing student's logical thinking and higher- order cognitive skills. Many other scientific fields, such as physics, statistics and engineering depend on mathematics, so mathematical proficiency is a prerequisite for understanding other subject areas.

One of the most important critical components of learning mathematics is solving word problems. Young pupils who are repeatedly exposed to and engaged in meaningful problem solving develop a repertoire of problem-solving strategies. However, students normally think that solving word problems is one of the hardest and most distasteful tasks in mathematics. Students' achievement and attitude towards mathematics is affected by mathematics anxiety (Hembree, 1990). The difficulty students' face arises from the fact that the students have to conceptualize the problem and decide on the correct mathematical procedure to solve it. Yet, actually comprehending the words that represent the problem and correctly interpreting them to arrive at the actual question is the basic difficulty that faces most. This becomes even harder for students whose native language is different from that in which the word problem is presented. Previous research studies done on the relationship between language proficiency and mathematical proficiency had conflicting views; some deemed that each proficiency is reliant on the other (Holton, Anderson, Thomas, and Fletcher, 1999, in Albert, 2001) while others decided that each was autonomous (Chomsky, 1975).

1.2 Statement of the Problem

In a thriving learning community where international schools are becoming widespread, the issue of the relationship between English proficiency, as English is used as the language of instruction, and the students' ability to solve word problems is becoming of great importance. Therefore, the researcher decided to investigate this issue by studying the effect the former has on the latter.

1.3 Objectives of the Study

The present study aims at:

- closely examining the connection between the third grade students' level of proficiency in English and their ability to solve Mathematical word problems.

- investigating some of the educational ways to better accommodate the instructional design for mathematical problem solving to meet the students’ needs.

1.4 Questions of the Study

To achieve these goals, the study attempted to address the following questions:

- What effect does the pupils' level of proficiency in the English Language have on their Mathematical problem solving skills?
- How can the instructional design for mathematical problem solving be altered to meet the students’ needs?

1.5 Significance of the Study

With the growth of international schools in Jordan being a recent trend, studies investigating the effect of the language of instruction on the students’ ability to perform in various other subject areas are comparatively low. There is a gap in the literature that this study aims to diminish.

The findings of this study may help explain some possible reasons that lie behind the students’ achievement in mathematical word-problem solving. Thus, if these reasons are better understood, researchers, administrators and teachers will be more capable of anticipating problems and designing alternative plans that would help ease the predicament at hand.

1.6 Limits of the Study

Results of the research are limited to the academic year 2016-2017 within which the study was conducted. The results are also limited to the effect of English language proficiency on mathematical problem solving skills specifically, and not any other subject area.

1.7 Limitations of the Study

The findings of the study cannot be generalized beyond the sample which was composed of 76 third graders at Mashrek International School. The results are also limited to the instruments used in the study, which are a test that was given to the students to assess the effect their proficiency in English had on their problem-solving skills, and the interviews conducted with the teachers, and the academic staff.

1.8 Definition of Terms

- **English Language Proficiency:** Language proficiency is defined theoretically by Bachman (1990) as language ability or ability in language use. Blagojevich, Ruitz and Dunn (2004) define language proficiency as learners' communication of information, ideas and concepts necessary for academic success in the content area of social studies. In this research, language proficiency is operationally defined as the learners' well developed capacity in the four basic English language skills: listening, reading, speaking and writing, and the overall comprehension of English within academic class-room settings.

- **Problem Solving:** Krulik and Rudnick (1980) define problem solving theoretically as "*the means by which an individual uses previously acquired knowledge, skills, and understanding to satisfy the demands of an unfamiliar situation. The student must synthesize what he or she has learned, and apply it to a new and different situation.*" (p. 4). The study's operational definition states that problem solving is the use of previously gained knowledge to arrive at a correct solution for a worded problem.
- **Skills:** The term "skills" is defined theoretically in the dictionary as the ability, coming from one's knowledge, practice, aptitude, etc., to do something well. Skills is defined operationally as the students' capability to perform well in the task presented to them.

Chapter Two

Review of Literature

2.0 Introduction

This chapter surveys the literature available on the relation between English language proficiency and mathematical problem solving skills. It is divided into two parts; the first deals with the theoretical literature concerning the matter at hand, including literature dealing with Cognitive Load Theory, and the relation between mathematics and English proficiency, while the other deals with the empirical studies done on similar topics.

2.1 Review of Theoretical Literature:

This section is divided into two subsections. The first deals with the theoretical literature explaining the relation between Cognitive Load Theory and its impact on learning, while the second concerns the theoretical literature dealing with the relationship between English, as the language of instruction, and learning mathematics.

2.1.1 Review of the Theoretical Literature concerning Cognitive Load Theory and Cognition

Sweller (1994) points out some of the factors which ascertain the difficulty of material that needs to be learned. He suggests that to reduce difficulty while learning or engaging in intellectual activities, which is widely believed to happen through schema acquisition and automation, Cognitive Load Theory (CLT) can be used for the structuring of information by focusing cognitive activity on schema acquisition. It is indicated that CLT can use instructional design to manipulate learning and problem solving difficulty. Sweller indicates that intrinsic cognitive load is stable for a given area as it is a fundamental constituent of the subject. Element interactivity characterizes intrinsic cognitive load. The learning of most schemas' elements must be done concurrently because these elements interact, and it is their interaction that is of the utmost importance. Intrinsic cognitive load will be high if interactions between many elements must be learned, whereas it is low if elements can be learned consecutively rather than simultaneously because they do not interact. Furthermore, it is suggested that extraneous cognitive load that obstructs learning is caused by high element interactivity. This condition of high element interactivity can be used to explain why some material is difficult to learn and to understand.

According to Cooper (1998), learning is described by CLT in reference with a system for processing information that includes long- term memory and working memory. Information is processed in working memory by methods of organization, comparing and contrasting.

Sweller, VanMerrienboer and Paas (1998) argue that because working memory is limited, humans can only handle two to three pieces of information simultaneously. If too much information is presented to the learner, along with the limitation of working memory, the effectiveness of learning objectives will be surely lessened. Leahy and Sweller (2004) assert that this limitation of working memory should be taken into consideration in the process of designing instructional materials.

Brunken, Plass and Leutner (2003) describe three types of cognitive load: intrinsic, extraneous and germane. Intrinsic cognitive load is inherent in the subject and determined by its complexity. For instance, learning a word in any foreign language is less complex than learning the grammar of the same language. This is the result of the syntax requiring an understanding of the words that make sentences, in addition to the rules of the order of words and the tenses that should be used (Antonenko and Niederhauser, 2010). Extraneous load, on the other hand, is known as unneeded information processing which comes from the instructional design rather than from the subject itself (Cierniak, Scheiter and Gerjets, 2009). Germane cognitive load is advantageous. It is relevant to rich schema acquisition and automation as it draws the learner’s attention towards the learning process. Automation is acquired through exposure and practice, and automation of schemas decreases cognitive load. For example, commonly used skills, like reading, can be done automatically, in a routine way and without effort, even though the connected tasks may be complicated (Burkes, 2007). Germane and extraneous cognitive load may be altered by the instructional design, whereas the intrinsic cognitive load remains unchanged.

Authors like Campbell, Adams and Davis (2007) conclude that the challenge students face is not merely misunderstanding key words in mathematical word problems, but drawing upon Cognitive Load Theory (CLT), they suggest that students perform less well since they face added cognitive demands for the duration of problem solving while working in a language other than their mother tongue. CLT postulates that the amount of information given to the user, while performing a complex cognitive task, either equals or exceeds the availability of working memory and this has great implications on the performance. The probability of mistakes increases when working memory capacity is exceeded (Ashcraft, Donely, Halas & Vakali, 1992; Kalyuga, Ayres, Chandler & Sweller, 2003). This means that if students dedicate considerable cognitive resources to text comprehension, less working memory resources will be left for mathematical problem solving, including identifying the suitable math operation, performing computations and seeing through to the solution. For the students who learn

English as a second language, the majority of working memory resources will be devoted to understanding the problem, so the amount of working memory dedicated to problem solving will be significantly reduced.

Cummins (1980) includes cognitive demands together with the formal/ informal distinction in characterizing oral language, which is reemphasized by Cummins (2000). The Basic Interpersonal Communication Skills (BICS), obtained and utilized in everyday interactions, and Cognitive Academic Language Proficiency (CALP), acquired and used in the context of the classroom are contrasted by his distinction. Cummins differentiates between Basic interpersonal communicative skills (BICS) which are used by students to express ideas related to everyday things in situations where the context provides cues that do not limit understanding on the verbal interaction alone, to which he refers as a conversational ability that is context embedded or contextualized, and Cognitive Academic Language Proficiency (CALP), which is the type of language proficiency required to read textbooks, to participate in dialogue and debate, and to provide written responses to tests. Thus, students who haven't improved their cognitive-academic language proficiency (CALP) could face difficulties while learning academic subject matters.

Other researchers, like Krashen and Biber (1987), Rosenthal (1996), and Spurlin (1995), also agree with Cummins in that CALP facilitates the learning process of students within a context that relies on oral explanation of abstract ideas. According to these researchers, this is often the context in which science is taught, away from familiar events and where students have little or no chance to negotiate the meaning mentioned.

2.1.2 Review of the Theoretical Literature Related to the Relationship between Language and Mathematical Learning

Pirie (1998) and Driscoll (1983) argue that mathematics symbolism is the mathematics itself and language serves to interpret the mathematics symbol. Brown and Setati view language as a medium through which mathematical ideas are expressed (Brown, 1997; Setati, 2005). Rotman, (1993, in Ernest, 1994) contends that mathematics is an activity which uses written inscription and language to create, record and justify its knowledge. According to Ernest (1994); and Lerman (2001) language plays a vital role in the genesis, acquisition, communication, formulation and justification of mathematical knowledge – and certainly, knowledge in general.

Barwell, Barton and Setati (2007) argue that learners, who are studying in a language other than their mother tongue, have to learn mathematical concepts, as well as the language in which these concepts are rooted.

Douady (1997) asserts that to know mathematics, a double aspect is required. The first aspect involves the acquisition of certain concepts and theorems, at a functional level, that can be used to solve problems and construe information, as well as being able to make new questions. The second aspect entails being able to recognize concepts and theorems as rudiments of a scientifically and socially recognised body of knowledge. It is also to be able to create definitions, and to state theorems belonging to this corpus and to prove them.

Clark's proposed model (1975) puts forward that language facilitates the learner's conceptual development, which is the result of the learner's experiences, through discussion and instruction. The model shows the different roles language plays in mathematics instruction. When different mathematical concepts are being learnt, different linguistic activities serve various purposes. Substantial proficiency in both the students' first and second languages is required if they are to cope with the range of linguistic activities required for learning mathematics.

According to Durán (1989), some of the factors that affect English language learners' performance in content-based areas include not being familiar with certain linguistic structures used in questions, not identifying vocabulary expressions, or misinterpreting an item literally. Tippeconnic and Faircloth (2002) contend the significance of language, as well as cultural factors in the testing of Ell students.

2.2 Review of Empirical Literature:

Abedi and Lord (2001) investigated how the students' test performance in mathematical word problems was affected by language. Students were given parallel items from the National Assessment of Educational Progress mathematics assessment, along with items that were customized to decrease their linguistic complexity. Students' interviews revealed that they favoured the revised items over their original counterparts. Paper-and-pencil tests were administered to 1,174 8th grade students. Students who were English language learners (ELLs) scored lower on the math test than proficient speakers of English. Socioeconomic status (SES) also resulted in differences in math performance but gender did not. Linguistic alteration of test items showed noteworthy differences in math performance; scores on the linguistically modified version were to some extent higher. Some student groups -predominantly, students in low-level and average math classes, as well as ELLs and low SES students- benefited more from the linguistic modification of items.

Abedi, Courtney and Leon (2003) used NAEP science items to test 1,854 Grade 4 students and 1,594 Grade 8 students from 40 school sites. The results showed that the linguistic accommodation had no performance effects for Grade 4 students. However, performance differences were seen for Grade 8. ELL students' performance was increased by the linguistically modified test version, but did not affect the performance of non-ELL students given the same adjustment.

Abedi, Courtney, Mirocha, Leon, and Goldberg (2005) investigated how accommodation affects the scores of ELL students in assessments. A sample of 611 Grade 4 and grade 8 students, of which 317 students were identified as ELL or limited English Proficient (LEP) and 294 students were either native English speakers or were proficient in English, undertook a science test for each grade level. The test, which consisted of multiple choice questions and open-ended released NAEP (National Assessment of Educational Progress) items, was given under four conditions. One condition had no accommodation, another included the provision of English dictionary, the third included the provision of a bilingual dictionary, and the fourth included linguistic modification of the test. The results indicated that some of the accommodations were useful, namely the use of an English dictionary and more so the linguistic modification of items.

Essien and Setati (2007) investigated how development of learners' English language proficiency facilitates or confines the improvement of mathematical proficiency. English Computer software was used as a method to improve the English Language proficiency of 45 learners. The pre- and post-tests were analyzed using statistical methods so as to compare these learners with learners from another class of 48. The findings of this study were that, first, developing the students' academic proficiency should aim at improving both the basic interpersonal communicative skills and the cognitive- academic language proficiency simultaneously; second, proficiency in the language of instruction (English) is an important index in mathematics proficiency, but development of learners' language proficiency, although important for achievement in mathematics, may not be sufficient to affect classroom interaction. The teacher's ability to utilize learner's linguistic resources is also of significant importance.

Koeze (2007) examined the effect of differentiated instruction on student achievement and whether there were components of differentiated instruction that impacted student achievement more than others. The study used surveys and tests along with classroom observation and teacher interviews. The results suggested that differentiation strategies based on choice and interest, after administrating a learning style inventory, had great effects on students' achievement and satisfaction in learning.

Barbu and Beal (2010) investigated the impact of linguistic complexity on solving mathematical word problems using an experimental design. The sample consisted of 41 middle school English learners from three middle schools in Tucson, Arizona. The study materials included booklets including eight mathematical word problems ranging in difficulty from easy-math, easy-English to hard-math hard-English problems. Results were aligned with predictions from Cognitive Load Theory: Performance in problems written in simple language was higher than performance of the same problems written in more complex language. The poorest performance was recognized for problems that were both mathematically and linguistically complex. The findings were consistent with the suggestions that the additional cognitive demands associated with text comprehension resulted in lower performance. Furthermore, items that were linguistically challenging had a considerable influence on students' perceptions of the problems' mathematical difficulty.

Eduardo and Saul (2013) conducted a study which analyzed quantitative data collected from the first (2002) and second (2004) waves of the Educational Longitudinal Study. The study aimed at examining the relationship between Latina/ o secondary school students' achievement in 12th grade mathematics, and their level of English language proficiency and mathematics course-taking measures. Findings from the study establish a strong relationship between Latina/o's mathematics achievement and the implementation of support to develop the students' proficiency in both mathematics and English.

Rambley, Ahmad, Majid and Jaaman (2013) investigated the relationship between English proficiency and mathematics achievement. The researchers used a sample of 118 students from Faculty of Science & Technology. Data was obtained from the assessment of a course taught at Universiti

Kebangsaan Malaysia. The test included four subjective questions given with different difficulty levels. The results of the study indicated that achieving excellent results in mathematics requires good mastering of English. The students with low English proficiency obtained lower grades in their course.

Gėnç and Gülözer (2013) investigated how students' second language reading comprehension overall performance was affected by the cognitive load effects of instructional formats and text presentation kinds. The tools implemented in the study comprised of a split- attention format, where the questions were presented at the end of the reading extract, and an integrated format where the reading text and paragraphs were integrated. The sample was tested by dividing them into four groups; Online Reading-Split Attention Format; Online Reading-Integrated Format; Paper-based Reading Split Attention Format; and Paper-based Reading Integrated Format. The results showed that in L2 comprehension, there was a statistically considerable difference between the respondents who read the online text and those who read the paper-based passage.

Kagasi (2014) investigated how children's performance during their learning of number recognition was affected through using manipulative learning resources. The results were obtained after administrating pre-tests and post-tests for the children in the participating schools, and through questionnaires for teachers. The sample consisted of 792 children and 60 teachers from 30 preschools. The results showed that the teachers' attitudes towards the use of manipulatives affected the frequency of their use during class time. The study's results also showed that using learning manipulative instructional resources assisted the students in learning number recognition, and they performed well while using manipulative resources.

Cekiso, Tshotsho and Masha (2015) studied the impact of English language proficiency on learners' academic achievement in Mathematics, Economic and Management Science and Natural Science. The end of year results were the criteria used to measure the learners' performance in the four mentioned subjects. A purposeful sample of 215 Grade 8 learners was used in this study. The results indicated that there was no connection between learners' English proficiency and their academic performance in Mathematics and EMS. The study revealed one, not very significant, relationship which was between the English language proficiency and learners' academic performance in Natural Science. It was concluded that there was no association between the existing structures of the English language subject presented and the language proficiency necessary for academic success in Mathematics and EMS.

Buba and Umar (2015) explored how the students' proficiency in mathematics and English affects their academic performance in financial accounting. The study's participants were 451 Business Education students drawn from 6 universities in northern states of Nigeria. The researchers used an achievement test using contents of lectures and problems taken from Financial Accounting text books. The results showed that gender differences affected the students' academic achievement. The results also showed that there was a positive association between proficiency in mathematics and English and in the students' academic performance in financial accounting.

Luchini, Ferreiro, and Colalillo (2016) explored the degree to which the redundancy effect influences the L2 reading comprehension skills of 24 Hispanophone English learners in their first year of high school at a private school in Mar del Plata, Argentina, using Cognitive Load Theory as a theoretical framework. The sample was divided into two groups: A and B. Each group completed the same reading comprehension task independently while using a different style of presentation. Group A was exposed to one mode of instruction: reading alone, while group B was exposed to a twofold format that integrated reading and listening concurrently. The same amount of time was allotted to both groups to work on task. Results indicated that group A (nonredundant group) outperformed group B (redundant group) in the task set.

Kontas (2016) examined the effect of using manipulatives on secondary school students' academic achievement and their attitudes towards mathematics. A sample of 48 seventh grade students was divided into a control group and an experiment group. The tools included a mathematics achievement test and an attitude scale for mathematics to collect data. Results of the study indicated that the academic achievement scores of experiment and control groups differed significantly in favour of post-tests in the two groups. Using manipulatives increased the achievement scores of the experiment group considerably. The scores of attitude were much higher for the participants assigned to the experiment group.

Bikić, Maričić and Pikula (2016) examined the effects of problem-based learning through differentiating the content in the processing of Analytical geometry. A sample of 165 secondary school students were chosen. The results suggested that using a methodical approach based on differentiation of content resulted in better student performance in geometry. Average and below average students benefited most from differentiating the content in the problem-based learning of geometry.

2.3 Conclusion

The reviewed literature showed that there is a relation between mathematics and English, as language is an integral part of communicating knowledge in an academic setting. Most of the studies indicated that there was a close and a noticeable relationship between mathematical problem solving and English when used as the language of instruction. The researcher made great use of the reviewed studies to develop the methodology used in conducting the study. The current study offers a chance to shed light on the relationship between English and mathematics in a new setting, namely Jordan. It also concerns young primary students who have been chosen as the sample, which makes it possible to collect new data that would help reveal the relationship between English and mathematical problem solving for students of a young age.

Chapter Three

Methodology

3.0 Introduction

The following chapter deals with the methodological approach used in the study. It shows how the data was gathered through the study's instruments, and explains how each instrument is constructed.

3.1 Method of the Study

The methodological approach adopted for the current study is a quantitative and qualitative one. The test provided the quantitative data which tackled the first question of the study, while the interviews offered additional information that expanded the understanding regarding the reasons behind the results from the teachers' perspectives. The interviews also shed light on the accommodations that must be undertook to alter the instructional design so as to maximize the students' potential while solving mathematical word problems.

3.2 Population and Sample of the Study

The population of this study consists of all third grade students currently enrolled in Mashrek International School in Amman, Jordan. A sample of 76 third-grade students from Mashrek International School was selected purposively to achieve the aim of the study. The sample consisted of 44 male students, and 32 female students, aged between 8-9 years old. The sample was divided into three groups on the basis of the students' level of proficiency in the English language. The advanced group consisted of thirty participants, the intermediate group consisted of twenty seven participants, while the basic group included 19 participants.

The demographic data of the participants included their gender and nationality. 66 of the participants are Jordanian students, while the rest have the following nationalities: two are Palestinian, one is Lebanese, two are American, one is Chinese, one is French, One is Albanian, one is Indian, and one is Spanish. All of the students have been learning in English as the language of instruction since they first entered the school.

3.3 Instruments of the Study

This study utilizes qualitative and quantitative methods in assembling and analyzing the required data. A test and open-ended interviews are both used in drawing the conclusions of the research.

3.3.1 The Mathematical Problem Solving Test

The first instrument used was a test designed to unveil the relationship

between English proficiency and mathematical worded problems which was implemented to collect the data required to answer the first question of the research. The test comprised of 8 mathematical word problems printed on booklets. The word problems included two easy-math-easy-English, two easy-math-hard-English, two hard-math-easy English, and two hard-math-hard-English problems. The test was adopted and adapted from the study conducted by Barbu and Beal (2010). Addition word problems, through single steps, were used as the easy math problems, whereas the difficult math problems involved single or multi-digit multiplication and division. Each word problem was designed to be presented in two versions, one that used easy-English, and one which was presented in hard-English. A semi- random order of the word-problems was used to ensure that the easy-English and hard-English versions of the same word problem did not follow each other immediately. The complexity of the word problems was changed by altering the vocabulary and grammatical structures used. To assess the difficulty of the word problem, an online readability assessment tool was used. This software calculates the text's difficulty by considering both vocabulary frequency and grammatical complexity. The test questions were based on the common core standards, and similar to the students' solving experience in everyday mathematics class. The items were revised and changed to create harder versions to make the problem solving test applicable and purposeful.

The students were divided into three groups based on their level of proficiency in English, which was determined based on the students' performance in the end of the first term summative assessments. The three groups consisted of students who were classified as having advanced, intermediate or basic levels of proficiency. The same test was administrated to the three groups, in order for the test to show whether the students' level of proficiency in the English language actually affected the students' performance in the mathematical problem solving test or not.

3.3.2 The Interviews

The second instrument was informal, open-ended interviews; the researcher conducted interviews with teachers and administrators to highlight the reasons which lay behind the students' achievement in the test. The interviews also revealed how the instructional design, from the interviewees' perspective, can be altered to better accommodate the students' needs.

3.4 Validity and reliability of the instruments

3.4.1 Validity of the Test

After preparing the test, it was given to a panel of four experts to find out whether the word problems examine what they are supposed to examine or not, to assure the validity of the test. Three of the experts were professors teaching English, and the fourth expert was an expert in the mathematics field. They were asked to comment on the test, and to propose any modifications that would better serve the aims of the research.

The test was commended on its suitability to measure the relationship between the students' level of proficiency in the English language, and the students' performance in solving the mathematical word problems. A few recommendations and modifications were suggested to improve the test. These recommendations, including making the easy-English versions of the word problems easier, were taken into consideration, and the test was modified accordingly.

3.4.2 Reliability of the Test

The test's reliability was established by means of test-retest. The mathematical word problems' test was administrated to one of the four grade-three sections at Mashrek International School. Depending on the amount of time used to complete the questions, the approximate time it would take the respondents to answer the test was determined. The participants were given 45 minutes to finish the test.

3.5 Data Analysis

The following procedures were followed to analyze the test:

1. After administrating the test, the researcher analyzed the students' responses and recorded the correct and wrong answers. On each problem, the students were given a score of 0 or 1 indicating whether the correct answer was achieved or not. Each student completed eight problems, two each for easy-math-easy-English, easy-math-hard-English, hard-math-easy-

English, and hard-math-hard-English. Scores and ratings were averaged across the two problems in each of these four categories for each student.

2. For each category, the researcher calculated the mean and the standard deviation to better explain the results. Then the frequency and percentages of correct answers were recorded to ease the process of comparison across the different levels.

3.6 Procedures

The following procedures were followed while carrying out the study:-

1. Collecting theoretical and empirical studies that are related to the topic
2. Determining the objectives and questions of the studies that are related to the topic
3. Administrating the problem solving test
4. Checking the validity of the test by submitting it to a panel of academic experts
5. Checking the reliability of the test by means of test-retest
6. Conducting the interviews
7. Analyzing the data
8. Drawing out the results and conclusions
9. Proposing the recommendations for further research

10. Recording the references according to APA style

11. Adding the appendices

Chapter Four

Results of the Study

4.0 Introduction

This chapter presents the results of the study with regards to its questions. Quantitative data was collected to answer the study's first question; to uncover the relationship between English, as the language of instruction, and mathematical problem solving skills, while qualitative data was gathered to explain the results of the test from the interviewees' perspective, and to answer the second question of the research.

4.1 Results of the Test

To answer the first question of the research, the results obtained were analyzed by calculating the mean and the standard deviation of the four main categories (easy-math-easy-English, hard-math-easy-English, easy-math-hard-English, and hard-math-hard-English) in an attempt to find whether a relationship between the students' level of proficiency and their ability to solve mathematical word problems actually existed or not.

Table (1) below shows the mean which is recorded with the standard deviation written next to it between parentheses. The frequency of the correct answers for both questions within the same category was also recorded, in addition to the percentage of the correct answers to make the comparisons between the advanced, intermediate and basic groups easier.

Each word problem is discussed separately. The students' performance, as shown in the table, evidently shows that the students' work was best for the easy-English easy-math problems, and poorest for the hard-English hard-math problems.

Table (1): Means, Standard Deviations, Frequencies and Percentages for the Problem Solving Test

		Advanced	Intermediate	Basic

Difficulty of English Text	Difficulty of Math Problem	Mean (Standard Deviation)	fr.	%	Mean (Standard Deviation)	fr.	%	Mean (Standard Deviation)	fr.	%
Easy English	Easy Math	0.93 (0.17)	56	93.3 %	0.75 (0.34)	41	75.9 %	0.42 (0.44)	16	42.1 %
	Hard Math	0.83 (0.27)	52	86.7 %	0.74 (0.34)	41	75.9 %	0.42 (0.37)	16	42.1 %
Hard English	Easy Math	0.83 (0.27)	50	83.3 %	0.70 (0.36)	38	70.4 %	0.29 (0.40)	11	28.9
	Hard Math	0.83 (0.27)	49	81.7 %	0.65 (0.36)	35	64.8 %	0.29 (0.37)	11	28.9 %

A) Easy-Math- Easy- English Question (1) and (2)

1) You can see a toucan in the rain forest with its long, colorful beak. A toucan's beak is usually 6 inches long. A toucan's body is usually 12 inches longer than its beak. How long is a toucan's body?

2) Very big bamboo plants grow in the thick rain forests. A very big bamboo plant can grow up to 9 inches every day. If one bamboo tree is 35 inches long, how long will it be after one day?

Using the online readability software, question 1 was rated as having an average grade level of about 5. This question was both easy in terms of the language used to show the story problem, and the mathematical operation the actual computation required. Question 2 was rated as an average grade 4 text. This question was also easy in terms of the mathematical operation it required, as well as the language used.

As shown in table (1), the students included in the advanced group, based on their advanced level of proficiency, performed best in this category. The performance mean in this category was 0.93 with a standard deviation of 0.17. The students included in the intermediate group also performed best in the questions solved within this category. The students' answers received a mean of 0.75, and a standard deviation of 0.34. Table (1) also shows that the basic group's performance in the same category was best compared to the other categories. The students' performance within the basic group received a mean of 0.42 and a standard deviation of 0.44. The low standard deviation within the three groups shows that the numbers are close to the average, which illustrates the consistency and proximity in the students' answers within the same group.

In terms of the frequency and percentage of the participants' correct answers, the advanced group obtained 56 correct answers for the easy-math-easy-English category, which shows an excellent percentage of 93.3%. In comparison, the intermediate group got 41 correct answers, which equals 75.9 %. The basic group received the lowest percentage, 42.1%, with only 16 correct answers.

The three groups' performance varies significantly across the same category. The advanced group did markedly better compared to the intermediate and basic groups.

B) Hard-Math- Easy- English Question (3) and (4)

3) Cashews, Brazil nuts, and peanuts originally grew in rain forests. Anne made a trail mix with 9 cups of each. How many cups of cashews, Brazil nuts, and peanuts did she use to make the mix?

4) Chocolate comes from the rain forest cocoa plant, but today most of the cocoa is grown by farmers. One ounce of milk chocolate has 9 grams of fat. How many ounces of milk have 18 grams of fat?

Both questions 3 and 4 were given an average grade level of about grade five. These questions were included in the easy English category because the texts were simple in terms of words and linguistic structures, and they were also included in the hard math category because they required higher level computational skills; including multiplication and division.

The table illustrates that the performance of the advanced, intermediate and basic group differs considerably, again, for this category. The advanced group performed well in this category with a mean of 0.83 and a standard deviation of 0.27. The intermediate groups' participants scored a mean of

0.74 and a standard deviation of 0.34, while the respondents in the basic group scored a mean of 0.42 and a standard deviation of 0.37.

The advanced group was in the lead again with the percentage showing the correct answers, the respondents had 52 correct answers which shows a percentage of 86.7 %. The intermediate group answered 41 correct questions, and they received a percentage of 75.9 %. The basic group scored 16 correct answers, with a percentage of 42.1%.

It is noticeable, again, that the frequencies and percentages of correct answers show a descending order from advanced to basic groups. The percentage of correct answers is reduced considerably moving from the advanced group, through the intermediate, to the basic group.

C) Easy-Math- Hard- English Question (5) and (6)

You can recognize a toucan in the rain forest by its stretched, multi-coloured beak. A toucan's beak is frequently 6 inches long. A toucan's body is typically 12 inches longer than its beak. What is the total length of a toucan's body?

Enormous bamboo plants sprout in the densely crammed rain forests. A giant bamboo plant increases 9 inches in length a day. How long will a 35 inches long bamboo tree be one day later?

These questions are the revised items of questions 1 and 2. Question 5 was rated as an average grade six question, while question 6 received an average grade 7 readability result. Some vocabulary items were altered and replaced by more challenging words to create the desired complexity effect.

As shown in table (1), the advanced group's participants did much better in this category when compared with the other groups, with a noticeable difference in the mean scored across the three different groups.

The advanced group scored a mean of 0.83 with a low standard deviation of 0.27. The intermediate group was next with regards to the accuracy of performance. The group's mean equalled 0.70, and the standard deviation was 0.36. The basic group got a lower mean than the two previous groups, which equalled 0.29 and the standard deviation measured was 0.40.

The advanced group had 50 correct answers in this category, with a high percentage of 83.3%. The intermediate group came next in terms of the percentage it received, which was 70.4% corresponding to the 38 correct answers. The frequency of the basic group's correct answers was 11, which was translated into a percentage of 28.9%

This category makes it even more obvious that the percentages become significantly less with each group's performance.

D) Hard -Math- Hard- English Question (7) and (8)

Chocolate is produced by the rain forest cocoa plant, but today the majority of the cocoa is cultivated by farmers. One ounce of milk chocolate contains 9 grams of fat. How many ounces of milk hold 18 grams of fat?

Cashews, Brazil nuts, and peanuts initially grew in rain forests. Anne made a trail blend with 9 cups of each. How many cups of the various kinds of nuts were used in total?

Questions 7 and 8 are the revised items of questions 3 and 4. The complexity of the word problems was modified by adjusting the vocabulary items and the grammatical structure of the questions. Question 7 was rated as an average grade 7, while question 8 received a readability result of about grade 6.

The advanced group achieved a mean of 0.83, and a standard deviation of 0.27. The intermediate group got its lowest mean in this category, which measured 0.65 with a standard deviation of 0.36. The basic group's mean was measured as 0.29 with a 0.37 standard deviation.

Forty nine correct answers were attained by the advanced group, with a percentage of 81.7%. This percentage is still considered a high one, especially when compared with the intermediate group, which got a 64.8% with its participants' 35 correct answers, and the basic group, which obtained a percentage of 28.9% with its respondents' 11 correct answers.

The percentages calculated for the hard-math-hard-English category show the lowest percentages in comparison with the other categories. This is an indicator that the students' faced the most difficulties while dealing with these questions. Yet, the advanced group got a high percentage compared to the other two groups.

4.2. Results of the Interview Questions

To comment on the results of the mathematical problem solving test and to answer the second question of the study, interviews were conducted with the students' home room teachers, in addition to the program coordinator and the head of primary school at Mashrek International School.

1. Comment on the test's results.

2. How can the instructional design for mathematical problem solving be altered to meet the students' needs?

The first home room teacher, Ms. Zeina Jabri, commented on the different groups' varying performance in the test by saying that the advanced students did an excellent job in the test simply because they understood the context within which the problem was presented easily and effortlessly, this facilitated the process of using the accurate mathematical operation to find the answer. She also said that the participants assigned to the intermediate group had trouble comprehending some questions and so performed less well. The basic group, she added, is made up of struggling readers who lack English proficiency and who were unsuccessful in the comprehension step, which resulted in a poor performance compared to the two other groups.

To answer the second question of the study, Ms. Jabri asserted that the instructional design may be altered by pre-exposing students to a diagnostic test to assess their fluency level; therefore, educators can adopt the philosophy of differentiation to enable students of all levels to solve the mathematical problems.

The second homeroom teacher, Ms. Heba Bishouti, asserted that the above level students (advanced group) excelled in answering all the questions since they have excellent English language skills and outstanding understanding of the mathematical concepts. On-level students (intermediate group) answered some of the questions because some of them faced difficulty in understanding the word problems, especially the harder versions of the word problems, and so weren't able to solve all the questions correctly. The below-level students (basic group) were the least successful in answering the questions due to their weakness in the English language, which resulted in not understanding the mathematical word problems.

Ms. Bishouti proposed that the teachers, or the program as a whole, may consider changing the instructional design by using simpler language when taking the basic group into consideration during planning for the lessons. She also suggested that the questions need to be related to areas of study familiar to the students, hence, the questions must focus on mathematical concepts through simple, familiar language, rather than overwhelm the students with new vocabulary words that are difficult and not age/ level appropriate. This will enable the students to dedicate their effort to solving mathematical problems, and not devote considerable energy to translating the word problem into mathematical symbols and operations.

In her answer to the first question, the program coordinator, Ms. Reema Kasem, commented that mathematical learning depends on symbols, but requires conceptual understanding of both language and mathematics. She also mentioned that students sometimes resort to thinking in their mother language to translate the mathematical word problems if their proficiency level in the language of instruction is low. In this case, translation acts as an agent to maintaining concentration in the learning process which facilitates solving word problems. She reasoned that the test's results show a clear and reasonable result which shows the relation between math and the language of instruction.

Ms. Kasem stressed the importance of using differentiation to alter the instructional design. She suggested that the content, process, product and the learning environment must undergo some kind of differentiation to ensure gaining the best results.

The head of primary school, Ms. Reem Dajani, stated that the test results are saying that the English Language level of proficiency and mathematical problem solving skills are directly proportional. She affirmed that this is true since math is mediated through language, and that writing and mathematics are both brain tools. Students need to analyze and understand the mathematical language to be able to solve the mathematical problem. Students will not be able to solve a problem without understanding the inputs and what is required.

Ms. Dajani recommended that teachers and educationalists have to bear in mind that students can’t learn how to read mathematical problems by limiting them to vocabulary items to mediate mathematics solely. Therefore, in order for the teachers and schools to meet the students’ needs, the instructional design has to be altered through using manipulatives and to describe the attributes of mathematical understanding by using oral self-language and terms. Teachers, then, have to alter the oral language to mathematical terminology. Through guiding questions, teachers emphasize on the precise mathematical language. Once the language is understood by the students, this will allow the students to acquire concepts and definitions that will aid them in the solving phase. This will facilitate the symbolic translation of language to mathematical equations, as the task will become relatively easy. She reckoned that to achieve this, time is needed, but later on, when students are asked to solve a mathematical problem, they will have no or little difficulty in understanding the embedded relationships, numbers and operational procedures necessary to arrive at a correct answer.

Chapter Five

Discussion and Recommendations

5.0 Introduction

This study aims at investigating the effect the students' English language level of proficiency has on their mathematical problem solving skills, and the accommodations that could be done to the instructional design to meet the needs of the students. This chapter presents a summary and discussion of the results of the two questions. It also interprets the results in the light of the reviewed literature. Additionally, it offers recommendations for further research.

5.1 Discussion of the First Question's Results

What effect does the pupils' level of proficiency in the English Language have on their Mathematical problem solving skills?

The participants generally performed best when they solved the easy-text version of the math problems which involved the simple arithmetic operations. The quantitative data clearly suggests that the students' level of proficiency had a great effect on the students' overall performance in the mathematical problems. The advanced group performed generally better than the other two groups in the questions presented in the four different categories. The table and results clearly show that the three groups' performance descends in quality and accuracy from advanced to basic groups for all the categories.

The major problematic areas faced by the students' while solving these questions included identifying the correct mathematical operation and carrying out the correct computations to find the answer. The students' ability to recognize which mathematical operation they should use while solving the word problems was negatively affected by the increasing complexity of the word problems.

The advanced group remained in the lead in the different categories with a very high mean. In the Easy-English-easy-math word problem, the students obtained a very high mean of 0.93 with a corresponding percentage of 93.3 % of correct answers. In comparison, the intermediate group's mean was 0.75, while the basic group received a mean of 0.42. The different groups got a higher mean in this category compared to the remaining ones, which clearly shows that the simplicity of the text, in addition to the relative easiness of the mathematical operation required, led to this result. The cognitive resources were almost fully dedicated to the problem solving, and there was no extra cognitive demands to lessen the concentration of the students.

The remaining categories witnessed a constant performance by the participants of the advanced group, which sustained a high mean of 0.83 through the easy-English-hard-math, hard-English-easy-math, and hard-English-hard-math word problems. In comparison, the performance of the intermediate and basic groups' participants descended with regards to the remaining problems. The complexity of the text or the mathematical operation required presented the participants with added cognitive demands that were the reason behind their performance. The intermediate group performed generally well with their means of 0.74, 0.70 and 0.65 respectively for the three respective categories. Since the participants of the intermediate group have a generally good level of proficiency in the English language, the means scored are largely acceptable. The basic group's participants, however, received means of 0.42, 0.29 and 0.29 for the three remaining categories, respectively. The results of the basic group evidently show that the harder the word problem became, especially the more complex the text was, the less well the performance was. Most of the students' problems resulted from their inability to fully comprehend the context of the problem, due to the complexity of the vocabulary items, which prevented the students from translating the words into the correct mathematical operation.

The performance of the students in the hard English categories was lower since the students were presented with extraneous cognitive load that created additional demands on the working memory resources. Since the working memory can only deal with a limited amount of information, the amount of information presented to the users exceeded the availability of working memory, and so the frequency of mistakes increased. This was due to the complicatedness of words that diverted the students' attention from the basic task; solving the word problem mathematically.

Results of the test are consistent with Abedi, Courtney, Mirocha, Leon and Goldberg (1999) whose modification of the test items linguistically, the equivalent of the easy versions of the word problems in the current test, proved to be beneficial and greatly affected the results.

Results of the test are also consistent with Abedi and Lord (2001) who investigated how the students' test performance in mathematical word problems was affected by language. The results of their study showed a remarkable difference in math performance where scores on the linguistically modified version were to some degree higher, mainly for the low group's participants.

Findings of the study partially agree with Abedi, Courtney and Leon (2003) whose linguistic accommodation for science items had no effect on the performance of grade 4 students, but affected the performance of grade 8 students.

The test's results agree with the findings of Anthony and Mamokgethi (2007) who asserted that proficiency in the language of instruction is an important indication to mathematical proficiency. This is unmistakably shown through the performance of the advanced, intermediate and basic groups whose performance depended largely on their proficiency in the language.

The test's results are in total agreement with Barbu and Beal (2010), whose instrument of research was adopted and adapted for the current study.

The findings of both studies are consistent with the suggestions that the extra cognitive demands, resulting from the need to comprehend the complex context, led to a lower performance.

The findings of the study are consistent with the findings of Mosqueda and Maldonado (2013) who found that there was a strong relationship between Latina/o's mathematics achievement and implementation of support to improve the students' proficiency.

The study's results are inconsistent with Cekiso, Tshotsho and Masha (2015) who concluded that there was no relation between the students' proficiency in English and their performance in Mathematics and EMS, as the current study showed a strong relationship between the students' level of proficiency in English and their mathematical problem solving skills.

5.2 Discussion of the Second Question's Results

How can the instructional design for mathematical problem solving be altered to meet the students' needs?

According to the experts' viewpoint, the instructional design for mathematical problem solving may be altered through a variety of ways. The first is through adopting the philosophy of differentiation. Differentiation provides different students with different paths to learning. It assures that students with different learning styles, and different abilities absorb information regardless of their differences. It allows all students to achieve the required objectives, but each at his/her own pace. A diagnostic test is required before differentiation is implemented. A diagnostic test would reveal the levels of the students and allow differentiation to be carried out accurately.

In order for differentiation to be implemented successfully, tasks and assessments should be differentiated. Mathematical word problems may be chosen to suit the prior knowledge of students, making the language purposefully simpler for the challenged students, while inserting new vocabulary items in other word problems to challenge the more capable ones. It may also involve differentiating the content that allows the information to be absorbed by the students. The delivering of information, which takes place through the teacher's lesson plan, should include exposing the students to different media, including videos, readings, lectures, and audios. In this case, differentiation is carried out in whole groups by allowing the students to experience the different media through which they can learn. Differentiating the assessments can be carried out in the same manner. The complexity of words in the word problems may be chosen to suit the different levels of students, so they can focus on the required mathematical operation rather than dedicate considerable energy to comprehend the context of the word problem.

The experts' advice is consistent with findings of Koeze (2007). The study's results indicated that grouping the students according to their learning styles, and implementing differentiation based on choice and interest affected the students' achievement greatly.

Using differentiation to alter the instructional design to meet the students' needs for mathematical problem solving is also consistent with Bikić, Maričić and Pikula (2016). The results of using differentiation of content led to better student performance in geometry.

Teachers can also manipulate the instructional design by choosing stories, for the word problems, that are familiar to the students. When integrating mathematics with other subject areas, through choosing a context that sounds familiar to the students, and that has been previously acquired, this will allow learning to happen through building schemas gradually and not concurrently. Once the students feel confident about the information they're dealing with, they will focus on the task at hand, which is mathematics, and ignore the unnecessary information that may result because of the difficult words that make up the word problems.

Another important way to alter the instructional design may include using a manipulative, an object that can be used by the user to perceive some mathematical knowledge by manipulating it. To overcome the challenge of facing too many cognitive demands at the same time, using manipulatives can ease the process by allowing the students to imagine what the vocabulary words stand for. This would also enable the students to feel concrete things, instead of only dealing with abstract numbers and ideas, which will create a comfort zone for the students and allow them to carry out their thinking in a visible manner.

This is in agreement with findings of Kagasi (2014) who investigated how using manipulative learning resources affected the students' performance in number recognition. The results showed that the manipulatives aided the students in learning number recognition, and their performance was positively affected.

Using manipulatives to accommodate the instructional design for mathematical problem solving is also consistent with findings of Kontas (2016). Secondary school students seemed to have an increased achievement score after using the manipulatives.

Teachers may also benefit a great deal from translating the oral self-language into mathematical terminology that must be learnt and used by the students. This task may happen through guiding questions that will eventually make the students understand the correct terms, concepts and definitions that must be used through mathematical learning. Once the students are capable of understanding the mathematical language, the process of translating language into mathematics will become fairly easy. Students will gain a repertoire of mathematical concepts, terms and keywords that will aid them in the process of problem solving and allow them to use the information provided in words to solve mathematical word problems.

Allowing the students to work in pairs and in small groups through the structure of the instructional design of the lesson would enable the students to collaborate to solve word problems through the lesson, which would prepare them to work individually during assessments. By organizing the seating arrangement of students in mixed ability groups, the advanced students would explain the questions and the contexts to the intermediate and basic levelled students, and aid them to solve problems through modelling how the process can be carried out. This would eventually lead the students to acquire new words, and deepen their understanding of the concepts and keywords found in mathematical problems, thus, they will be trained to solve problems on their own later on.

5.3 Conclusions

Results obtained from the test indicated that the level of English proficiency directly affected the students' problem solving skills. The students who were classified in the advanced group obtained higher results compared to the intermediate and basic levelled students. The more complex the word problems became, the more difficulties the students, especially in the intermediate and basic levels, faced.

In the easy-math-easy-English word problems, the advanced group received a mean of 0.93, which was the highest compared to the intermediate and basic groups with their means of 0.75 and 0.42 respectively. The same results, in terms of the students' achievement, were replicated through the remaining categories. In the hard-math-easy-English category, the advanced group, once again, got the highest mean of 0.83, while the means for the intermediate group was 0.74 and for the basic group was 0.42, in that order. In the remaining categories, the advanced group maintained its mean scores regardless of the complexity of the word problems, with a mean of 0.83 for the easy-math and the hard-math versions. In comparison, the intermediate and basic groups got a mean of 0.70 and 0.29 respectively for the easy-math version, and 0.65 and 0.29 for the hard-math version of the harder text.

Results of the interviews with academic experts and educationalists elucidated that the instructional design may be altered to accommodate for the individual students' needs through using the framework of differentiation, whether in tasks, content, or assessments, choosing word problems that tackle situations that the students have already learned about or encountered, using manipulatives to ease the translation of abstract ideas into concrete, or visual, representations, in addition to using oral self-language and translating it into mathematical terminology to allow students to acquire the needed definitions and theorems that would enable them to translate the language into mathematical symbols and equations.

5.4 Recommendations

In light of the study's findings, the researcher proposes the following recommendations:

1- Teachers, academic leadership staff, and educationalists must be familiar with the relationship between the students' level of proficiency in the language of instruction and their mathematical achievement.

2- Teachers and educationalists have to acquire sufficient knowledge to be able to alter the instructional design to meet the individual students' needs so they can achieve the required objectives. The complexity of mathematical word problems must be modified depending on the students' level of proficiency.

3- Differentiating the content, tasks, or assessments for students grouped according to learning styles or abilities is required to ensure the success of all students.

4- Peer-Teaching is an advantageous method that allows students to benefit from each other's expertise and understanding to acquire knowledge that would help train the lower levelled students to solve mathematical word problems.

5- Using manipulative resources is capable of lifting the understanding of students' to a higher level, since it provides students with tangible objects to manipulate through mathematical learning.

6- In order for schema acquisition to be done successfully, information must be given to the user step by step rather than simultaneously. This means that new vocabulary items must be introduced to the user prior to contextualizing them in a word problem, to allow the students to devote their cognitive resources to one task rather than two.

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Appendices

Appendix (A)

The Mathematical Problem Solving Test

1. You can see a toucan in the rain forest with its long, colorful beak. A toucan's beak is usually 6 inches long. A toucan's body is usually 12 inches longer than its beak. How long is a toucan's body?

2. Very big bamboo plants grow in the thick rain forests. A very big bamboo plant can grow up to 9 inches every day. If one bamboo tree is 35 inches long, how long will it be after one day?

3. Cashews, Brazil nuts, and peanuts originally grew in rain forests. Anne made a trail mix with 9 cups of each. How many cups of cashews, Brazil nuts, and peanuts did she use to make the mix?

4. Chocolate comes from the rain forest cocoa plant, but today most of the cocoa is grown by farmers. One ounce of milk chocolate has 9 grams of fat. How many ounces of milk have 18 grams of fat?

5. Chocolate is produced by the rain forest cocoa plant, but today the majority of the cocoa is cultivated by farmers. One ounce of milk chocolate contains 9 grams of fat. How many ounces of milk hold 18 grams of fat?

____

____

6. You can recognize a toucan in the rain forest by its stretched, multi-coloured beak. A toucan's beak is frequently 6 inches long. A toucan's body is typically 12 inches longer than its beak. What is the total length of a toucan's body?

____

____

7. Enormous bamboo plants sprout in the densely crammed rain forests. A giant bamboo plant increases 9 inches in length a day. How long will a 35 inches long bamboo tree be one day later?

____

____

8. Cashews, Brazil nuts, and peanuts initially grew in rain forests. Anne made a trail blend with 9 cups of each. How many cups of the various kinds of nuts were used in total?

____

____

Appendix (B)

The Interview Questions

Dear Madam,

I am Reem Hisham Abuqutaish, an M.A student enrolled in the Middle East University. I am currently working on my thesis titled " The Effect of English Language Level of Proficiency on Mathematical Problem Solving Skills For Third-Graders at an International School in Amman."

Based on your experience and knowledge in the fields of Education, Teaching English and Mathematics, I would like you to ask you to kindly answer the below questions which target the relation between English and mathematics.

Your time, help, effort, and cooperation in answering the following questions are highly appreciated.

Reem Hisham Abuqutaish

Middle East University

Jordan-Amman

Reem.abuqutaish@mashrek.edu.jo

0796246401

Please add the personal information :-

1.Name…………………………………….

2.Specialization……………………………

3.Place of the work…………………………

4.Work experience………………………….

Please answer the followings questions:-

1. **Kindly comment on the test's results.**

____
____
____
____
____
____

2. **How can the instructional design be altered to meet the needs of the students?**

____
____
____
____
____
____

Appendix (C)

Interviewed experts

Name	Work Experience	Place of work	Years of Experience
Ms. Heba Bishouti	English Homeroom Teacher	Mashrek International School	4 years
Ms. Reem Dajani	Head of Primary School	Mashrek International School	3 years
Ms. Reema Kasem	Primary Years Program Coordinator	Mashrek International School	3 years
Ms. Zeina Jabri	English Homeroom Teacher	Mashrek International School	6 years

Appendix (D)

Suggested Answers

1. You can see a toucan in the rain forest with its long, colorful beak. A toucan's beak is usually 6 inches long. A toucan's body is usually 12 inches longer than its beak. How long is a toucan's body?

12 + 6 = 18 inches long.

2. Very big bamboo plants grow in the thick rain forests. A very big bamboo plant can grow up to 9 inches every day. If one bamboo tree is 35 inches long, how long will it after one day?

35 + 9= 44 inches long

3. Cashews, Brazil nuts, and peanuts originally grew in rain forests. Anne made a trail mix with 9 cups of each. How many cups of cashews, Brazil nuts, and peanuts did she use to make the mix?

3 x 9= 27 cups of cashews, Brazil nuts and peanuts.

4. Chocolate comes from the rain forest cocoa plant, but today most of the cocoa is grown by farmers. One ounce of milk chocolate has 9 grams of fat. How many ounces of milk have 18 grams of fat?

18÷ 9= 2 ounces of milk.

5. Chocolate is produced by the rain forest cocoa plant, but today the majority of the cocoa is cultivated by farmers. One ounce of milk chocolate contains 9 grams of fat. How many ounces of milk hold 18 grams of fat?

18÷ 9= 2 ounces of milk.

6. You can recognize a toucan in the rain forest by its stretched, multi-coloured beak. A toucan's beak is frequently 6 inches long. A toucan's body is typically 12 inches longer than its beak. What is the total length of a toucan's body?

12 + 6 = 18 inches long.

7. Enormous bamboo plants sprout in the densely crammed rain forests. A giant bamboo plant increases 9 inches in length a day. How long will a 35 inches long bamboo tree be one day later?

35 + 9= 44 inches long

8. Cashews, Brazil nuts, and peanuts initially grew in rain forests. Anne made a trail blend with 9 cups of each. How many cups of the various kinds of nuts were used in total?

3 x 9= 27 cups of cashews, Brazil nuts and peanuts.

Appendix (E)

The Validation Letter

Dear Professor ,

I am Reem Hisham Abuqutaish, an M.A student enrolled at the Middle East University. I am currently conducting a research entitled " The Effect of the English Language Level of Proficiency on Mathematical Problem Solving Skills For Third-Graders at Mashrek International School in Amman."

With your expertise, I am humbly asking you to validate the suitability of the attached mathematical word problems which are going to be used to unveil the relationship between English, as the language of instruction, and mathematical problem solving.

Your time, help, effort, and cooperation in commenting on the following are highly appreciated.

I am looking forward that my request would merit your good response.

Sincerely Yours,

Reem Hisham Abuqutaish

Middle East University

Jordan-Amman

reem.abuqutaish@mashrek.edu.jo

0796246401

Kindly write your personal information :-

1.Name…………………………………….

2.Specialization……………………………

3.Place of the work…………………………

4.Work experience…………………………

Appendix (F)

The Validation Committee

Name	Specialization	Place of work
Prof. Elias Dabeet	Mathematics and Statistics	Arab American University
Dr. Insaf Abbas	English Literature/ English Teaching Methods	Al-Quds Open University
Dr. Majid Abdulatif Ibrahim	General Linguistics/Phonetics and Phonology	Middle East University
Dr. Mohammad Al-Hanagtah	Translation	Middle East University

Appendix (G)

The Readability Assessment Tool