A PERSONAL STORY OF A HMONG STUDENT'S LEARNING OF MATHEMATICS IN SCHOOL: A CASE STUDY

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Moua V. Xiong

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DEDICATION

This is dedicated to both of my parents who gave life, love, support, and encouragement to me especially that they brought me to the United States to have the opportunity to go school and pursue my college degrees.

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ABSTRACT

A PERSONAL STORY OF A HMONG STUDENT'S LEARNING OF MATHEMATICS IN SCHOOL: A CASE STUDY

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Master of Science in Mathematics Education

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This thesis examines the process of a Hmong student learning mathematics on the community college level. The researcher selected a Hmong student from Butte College to conduct an interview regarding his educational experience but focused mainly on mathematics. The interview took approximately eight weeks, and each interview took about an hour with three interviews performed each week. The researcher also interviewed the participant's parents to gather information regarding their family background to support this Hmong student's learning experience.

The results indicated that this Hmong student learned mathematics in school by examples provided by the instructor. He relied on his memorization abilities to remember the mathematical-solving procedures. He practiced diligently to prepare himself to solve problems for in-class tests. The results also revealed that motivation was the key to inspire this Hmong student to go to school and to study. The participant

identified five roots of motivation that inspired him to continue his education, especially in mathematics such as parent's support, people's admiration, desire to compete successfully in the classroom, interest in assisting others, and the desire to be a role model for younger siblings.

This study showed that 78.97% of all mathematical word problems were translated into the Hmong language before translated into algebraic symbols. The other 21.03% was translated straight from the word problems written in English to algebraic equations by the participant. In addition, 81.48% of all the word problems, regardless of the English language structure, were translated word by word from left to right. The remaining18.52% of all the word problems was *not* translated from left to right due to the same English language structure.

During the interviews, the researcher provided 31 word problems that came from four different types of mathematical word problems for the participant to solve. The accumulative percentages from all mathematical word problems performed by the participant were 64.5% correct vs. 35.5% incorrect. Moreover, this study revealed that the participant was able to get 1) 100% of all mathematical word problems written in Hmong language correct; 2) 80% of the mathematical word problems that the participant had correct was coming from left to right translation; 3) 20% was coming from basic English sentence structure; and 4) 0% correct from mathematical word problems written in English complex language structure. Accordingly, the translation of the written word into algebraic language created most errors due to language barriers for the participant.

CHAPTER I

INTRODUCTION

Hmong Background

History

An ethnic group with no country of their own, the Hmong people fled from Laos to the United States after the Vietnam War in 1975 (Duffy, Harmon, Ranard, Thao, & Yang, 2004). The origin of the Hmong people is difficult to trace, even in the present. According to myths, the Hmong people originated from Central Siberia. This belief is due to the idea that the Hmong people have similar traditions to the Siberians; such as spiritual leaders called “shamans” (Thao, 2004). Many anthropologists and researchers, however, believe that the Hmong people lived in China as early as 2000 B.C. (Bankston, n.d.). The Hmong resided in the high mountainous regions of China, which allowed them to defend themselves from their enemies (Bliatout, Downing, Lewis, & Yang, 1988). They practiced fire fields’ agriculture, also known as “slash-and-burn” or “shifting cultivation,” and raised domestic animals for their daily survival (Lee, 2005b).

The slash-and-burn agricultural technique involves cutting down trees and burning the forest to make more space for farming (Yang, 2009). The Hmong people did not inhabit a particular area for long periods of time. Their migration allowed for farmland and old fields to reforest. After several years, they would move back to the old

location or find new fertile land to farm again (Thao, 2004). Hmong's planted rice, corn, and opium in abundance, especially rice since it was a staple of their diet. Corn was mostly used to feed domestic animals and opium was used for medicinal reasons as well as a trade commodity (Lee, 2005b).

China’s heavy taxes, territorial expansion, forced assimilation, and unauthorized seizure of Hmong lands, caused the Hmong to battle with the Chinese to protect their property (Bankston, n.d.). The wars between the Hmong and the Chinese forced almost every Hmong into battle with the Chinese (Xiong, 1997). After the Hmong lost to the Chinese, thousands of the Hmong who survived the wars emigrated from China to the remote mountainous regions of Southeast Asia (Crevier, 2002). According to Dr. Yang Dao, the first Hmong male to earn a doctoral degree in France, the Hmong people began to journey from China to Laos and Vietnam between the years of 1810 and 1820 (Bliatout et al., 1988).

After the Hmong immigrated to Laos and Vietnam, they discovered that other tribes had already occupied the valley, so they decided to inhabit the higher, mountainous regions (Ranald, 2004). Hmong were able to adapt their cultivation techniques to the higher lands and were able to grow rice, corn, and opium for their daily survival (Lee, 2005b). The Hmong were finally able to reside peacefully along the border of Laos and Vietnam until the French entered Indochina in the year 1890 (Lee, 1982).

Despite the French tax system and the forcing of many Hmong men between the ages of 18 and 65 years to work for the French to pay their debt, the Hmong were still able to raise arms against the French on two occasions (Chan, 1994). The best-known anti-French war was known as the Pa Chay War from 1918 to 1921 that was led by Pa

Chay, a Hmong man (Bankston, n.d.). After the Pa Chay War, the French rules of economics began to change (Ranald, 2004). The French gave more freedom to the Hmong people and allowed the Hmong to govern their own population in the province of Xieng Khouang. The Hmong were the first minority group in Laos that earned the right to govern themselves at the provincial level (Thao, 2004).

When the Indochina War broke out, many Hmong supported the French and fought against North Vietminh (Chan, 1994). When the French defeated the North Vietminh in 1954 many Hmong fled to the jungle to escape North Vietnam's persecution, while other Hmong still fought against the North Vietminh even though the French had already retreated from the Nong Het (Lee, 1982). In the meantime, the United States had a growing concern that Laos, Thailand, Burma, Cambodia, and South Vietnam would transition to communistic countries resembling China (Ranald, 2004). The United States, therefore, began to supply aid directly to Laos and recruited armies to prevent the North Vietminh from entering Laos (William, 2008).

The Vietnam War broke out along the borders of Laos and Vietnam and scattered from village to village, including Hmong villages on the high mountainous regions of Laos (Thao, 2004). The United States knew that Hmong were a minority group that were very skilled fighters, and that they were already aiding the French in the fight against the North Vietminh; so the United States C.I.A began to search for Hmong people to assist them (Hamilton-Merritt, 1999).

In 1960, a United States agent, Colonel Billy, began to search for General Vang Pao in the jungle. Billy consulted with Vang Pao and asked him to assist the United States against the communists. This union of powers and the seceding wars thereafter

became known as the “Secret War.” The United States, in addition, promised Vang Pao and the Hmong people that if the Hmong could pull the North Vietnam troops back from Laos, the United States would help the Hmong people as much as possible. However, if the Hmong were defeated by the North Vietnamese, the United States would find a new place for the Hmong people to start their new lives (Chan, 1994). General Vang Pao agreed to what was promised, so he began to recruit Hmong men from village to village in Northern Laos. At the same time the United States began to train the Hmong men and provided weapons for them (Linday, 2002). The Hmong’s priorities, as assigned by the United States, were to rescue American pilots if they were shot down and fight the ground war (Thao, 2004). The Hmong were also trained for fly combat missions such as Lee Lue, a Hmong man who flew as many as 10 missions per day, which was more than any other pilot in the kingdom of Laos at that time (Hamilton-Merritt, 1999).

The Hmong people supported the United States’ fight against North Vietnam for approximately 15 years. Approximately 30,000 or 10 percent of the total Hmong population was killed in the war. When the United States retreated from Laos in 1975, the Hmong population became the target of genocide, attacks, and chemical warfare from the North Vietnamese and the Pathet Lao (Xiong, 2007). Many Hmong wanted to escape from the persecution of North Vietnam and the Pathet Lao, so they sought refuge, emigrating from Laos to Thailand (Lee, 2005a).

When the Hmong people arrived in the Thai refugee camps, thousands of them began to journey to the United States and various other countries. According to Bliatout, et al. (1988), in January 1976, some 150 Hmong families, numbering about 750 people, formed the first Hmong contingent coming from the Thai refugee camps to the

United States. The Hmong people came to the United States with no choice in the matter, not as immigrants, but as refugees. They came to the United States as refugees because they wanted to escape the persecution from Pathet Lao and the North Vietnamese (Candace, 1992). The Hmong population increased dramatically after they moved to the United States. According to the U.S. Census Bureau of 2010, the total Hmong population in the United States was about 260,076. Hmong reside most heavily in the states of California and Minnesota (National Hmong Development, Inc., 2011, 2).

Socialization

The Hmong people divided themselves into 18 clans, clans consisted of men, wives, and unmarried women. Everyone within a clan could not marry each other regardless of how much the couple loved each other. For example, a male of the Xiong family could never marry a female of another Xiong family. He is only allowed to wed someone from another clan. This situation applied similarly to the girls in the same clan (Moua, 2003). When a woman gets married, she will belong to a new clan, her husband's clan even though she will continue to keep her original last name (Tolentino, 2009).

In addition, each clan had a leader, and the leader of the clan was a person who conferred marriage, divorce, and so on (Yang, 2004). Besides the leader of each clan, the father of the household was the dominant person in a family. He was the one who made the decisions, and would pass the authority to the eldest son in the family, if he passed away or retired (Tolentino, 2009). The men, in addition, assumed the responsibility for conversations, teaching the sons, weaving mats, baskets, and making and maintaining farming and hunting implements. Women, on the other hand, had different roles in the family. Women took on the role of preparing meals, instructing the

daughters in food preparation, sewing, and crafts (Miyares, 1997). In addition, women did not have a voice when it came to family matters, and would not make any decisions without discussing it with her husband or the elders. Women had to obey whatever decisions made by the head of household or their father (Duffy et al., 2004).

Hmong socialization has changed quite dramatically since their arrival in the United States. The Hmong people have assimilated themselves into mainstream society. Both males and females in Hmong-American communities take on the same roles as in contemporary society (Yang, 2004). Both husband and wife would have to obtain jobs in order to raise a family. Moreover, Hmong men and women came to take an equal responsibility for the family, a characteristic adapted from the American culture (Kaiser, 2004).

Culture

The Hmong are an ethnic minority group that migrated to the highlands of Vietnam, Laos, Thailand, and Burma approximately 200 years ago from Southwestern China. The Hmong people believe in animism, usually referred to as a “shaman.” The Hmong people also believe in supernatural beings, and that everything on earth has spirits; including rocks, puddles, trees, streams, hills, etcetera, even human beings (Tatman, 2004). According to Gerdner (2008), each body has multiple souls, and these souls must remain within a body in order to maintain the well-being. When a person is ill, it is believed that evil spirits have taken souls away from the person’s body, or souls have separated from the person’s body. A ritualistic ceremony must be done to recall the souls back to the owner’s body in order for the person to heal. There are several kinds of traditional ceremonies, but the most important one is a healing ceremony performed by a

shaman. If the ritualistic ceremony does not take place, and the souls do not come back to the body, it can result in further illness, or even death (Livo & Cha, 1991).

When a shaman performs the healing ceremony by calling the souls back into the owner's body, an animal is sacrificed to the evil spirits to pay for, or replace the souls. The shaman would negotiate with the evils to see which animal the evils will accept in order to release the souls back to the person's body (Viste, 2007). The most used animals are chickens and pigs, which would be sacrificed during a healing ceremony (Kalantari, 2012). However, when the Hmong arrived in the United States, many assimilated their cultural beliefs. Many of them started attending church and following Christianity. They started abandoning beliefs in supernatural and spiritual entities (Viste, 2007). Nevertheless, the majority of the Hmong people living in the United States and other countries still believe in their own traditional culture. Shamanism is still an important feature to the Hmong people because of the shamans' ability to travel to the supernatural world to retrieve lost souls (Gerdner, 2008). Furthermore, many Hmong still believe that supernatural entities cause illnesses and death, so they rely heavily on shamans (Viste, 2007).

Education

The Hmong did not have their own alphabet and writing system for many centuries, since their origins in China. The Hmong sent their messages from person to person, and from village to village, through verbal messages and memorization only. The Hmong elders were the ones that were responsible for the collective memory, and who passed the knowledge to their children from generation to generation (Vang, 2011). In the mid-20th century, a group of French missionaries and their Hmong colleagues decided to

design a Hmong alphabet and writing system for the Hmong people (Bliatout et al., 1988).

The Hmong writing system stems from the Romanized Popular Alphabets that consisted of French, German, and English. This made it convenient to translate the Bible and other works of western culture into the Hmong language (Thao, 2004). Dr. Yang Dao reported that about 99 percent of the Hmong population in Laos could not read and write in Hmong 20 years after the creation of the Hmong alphabet (Bliatout et al., 1988).

Upon their arrival in the United States, the Hmong lacked educational experiences. It was difficult for the Hmong to live and adjust to mainstream society, and the educational system (Bankston, n.d.). When the Hmong children attended school, they could not communicate to their teachers and other students whether or not they understood the course materials (Lor, 2008). A survey of the West Coast conducted in 1982 showed that about 70 percent of the Hmong population in the United States had no education; because they didn't have a formal education in Laos (Pfeifer, 2004).

According to the 2000 U.S Census the Hmong population had increased their educational attainment dramatically from 1990 to 2000 (Thao, 2004). The data indicated that 11 percent of the Hmong population earned a High School Diploma, 3 percent earned either an Associate Degree or a Bachelor Degree in 1990, with no report of higher degrees. By 2000, the proportion had changed from 11 percent to 27 percent of the Hmong population earning a high school diploma. The percentage also changed for attaining an Associate or Bachelor's degree from 3 to 11.7 percent. Furthermore, about 1.5 percent of Hmong earned either a Master's Degree or higher in 2000 (Lee et al.,

2004). This result indicated that the Hmong educational attainment had improved a lot within a decade in the United States (Pfeifer, 2004).

Statement of the Problem

As a mathematics tutor for approximately 5 years and a part-time mathematics instructor for nearly a year at Butte College, the researcher noticed that many students, especially Hmong students, struggled to translate mathematical word problems into mathematical equations. The researcher was interested to know what caused the Hmong student difficulty in translating mathematical story problems into algebraic equations. The researcher did not understand whether the Hmong students struggled with language or with mathematical concepts. It was also possible that the Hmong students had an issue with combining all necessary pieces of information from the passage to express a mathematical equation. Given the lack of research conducted to date, it seemed appropriate to conduct a case study about Hmong student's learning of mathematics in school.

Purpose of the Study

The purpose of this study is to seek an insight about how a Hmong student learns mathematics in school and how the Hmong language affects this Hmong student's mathematical experience. The researcher will select a Hmong student at Butte Community College to interview regarding his or her educational experience, focusing primarily on mathematical experience. The researcher is trying to understand how this Hmong student handles mathematical word problems, how he or she translates

mathematical applications into algebraic equations, and what strategies he or she uses to overcome mathematical story problems.

Significance of the Study

There has been some research in the past talking about the Hmong students' educational experiences in the United States, but none or few of them focused specifically on a Hmong student learning mathematics. Therefore, this study is very important as it may provide insight into a Hmong student's learning of mathematics and help to identify productive research questions for further research. The case study may also provide teachers of Hmong students with insight to how Hmong students learn mathematics. Finally, it may help Hmong students and their community better understand a Hmong student's mathematical experience.

Limitation of the Study

The Hmong student that the researcher selected to interview and to participate in this project was born in another country such as Thailand or Laos before he or she came to the United States. The student did not need to be a top student in the class. He or she might be an average student. Also, the student could be any gender, but the student was being able to read and write in Hmong. The student needed to be fluent in Hmong, and the student primary language must be Hmong because the student would require performing some mathematical word problems written in both languages during the interview.

Definition of Terms

- Algebraic language = Mathematical equation, mathematical symbol, algebraic equation, or algebraic symbol
- Complex language = Mathematical word problems that may use more complex vocabulary, difficult to understand, and requires references in order to translate the words into a mathematical equation correctly
- Hmong = A minority group of people that came from Southeast Asia (Laos) to the United States after Vietnam War
- Hmong language = A language that speaks by Hmong
- Language barriers = Context or words that a person cannot know and understand the definition of
- Left to right of Hmong language = The Hmong language is speaking strict from left to right and also translating strict from left to right. The sequential order is matter and important
- Left to right problem = Simple mathematical word problem that is written from left to right and also translated directly from left to right
- Limited of Hmong Word = No English equivalence of the Hmong word due to the Hmong language's few words compared to the English language
- Mathematical word, story, or application problem = Algebraic equations that are written in words or presented as a story
- Simple language problem = Mathematical word problem using simple vocabularies, read from left to right, and does not require any references

- Uncommon terms = Words that does not exist in the other language (i.e. Hmong)
- Vocabulary = Mathematical vocabularies that mean the same when defined from English to Hmong
- Written language = Mathematical word, story, or application problems

CHAPTER II

REVIEW OF LITERATURE

Mathematics is one of the most critical subjects in school, and it plays a central role in all work activities related to a human life (Barrow, 1992; Lover, 2004). Mathematics is a function of the brain, and it is very important for everyone to obtain knowledge and skills in math in order to function well and find a suitable job in modern society (Broyles & Pittard, 2011).Society requires that everyone, especially mathematics students, understand the significance of this subject and are able to apply mathematics to real-life in problem-solving situations (Posamentier, Smith, & Stepelman, 2006). People use mathematics in their everyday lives for shopping, paying bills, building houses, constructing bridges, constructing roads, and so forth, this is especially true with respect to anything related to the field of science (Rosid, 2009). In order to use, understand, and apply mathematics in real life, many years of studying mathematics are required (O'Neill, 2011).

Cause of Mathematical Misconceptions

When students work on mathematical problems, especially word problems, students have a difficult time translating mathematical phrases into mathematical equations prior to solving the problems. Perhaps, mathematical word problems represent the most difficult type of math problems for all students, but such problems can be

especially confusing and challenging for bilingual students. The fact that many students struggle with mathematical word problems does not necessarily mean that they cannot read and cannot do algebra. The mistake mainly stems from the misreading and mistranslating between mathematical word problems and mathematical equations (Lochhead & Mestre, 1988). Gerace and Mestre (1983) state that the most difficult steps in solving problems using conventional written language are the steps of translating a mathematical word problem to a mathematical equation, and this process of translating written language into algebraic language is very important for students' success in learning and mastering mathematics.

Mathematics is the universal language of science and technology, and accordingly, the learning of mathematics becomes similar to the learning of a new language. This is especially relevant with respect to students who are unfamiliar with the basics of mathematics (Reyes, Delgado, Lim & Chen, 2008). When students do not understand the problem statement, they do not take much time to think about the problem statement; they may rather take an educated guess on their translation (Mestre & Royer, 1988). According to Riordain and O'Donoghue (2008), language is a key for teaching, learning, understanding, and communicating in mathematics. Mathematics is meaningful and valuable to everyone through the use of language, so students must first enable communication adequately in the language of mathematics. Students need to obtain mathematical skills and be proficient in the mathematical language in order to translate the written language into algebraic language (Gerace & Mestre, 1981). As for the English Language Learners (ELLs), it is necessary to be proficient, in both languages,

mathematical language and English language, in order to perform well (Neville-Barton & Barton, 2005).

According to Robertson (2009), mathematical language is an issue to ELLs because the mathematical vocabulary is different from common English definition, and there may not be an equivalent word in other languages, which means that the meanings of some mathematical terms are not the same, across languages. Bilingual students are required to spend time familiarizing themselves with the mathematical language to be able to communicate proficiently in the language of mathematics in order to perform better on numbers and symbols (Riordain & O'Donoghue, 2008). In addition, mathematical vocabularies play a significant role to students, especially when they translate word problems into algebraic equations. Students need to understand mathematical vocabulary, communicate actively, not just in English but also in the mathematical language, and have adequate time to practice this vocabulary (Robertson, 2009).

Several studies in the past showed that many bilingual students performed below average on mathematical word problems. This does not necessarily mean that they could not perform algebra or that they could not read the problem statement, but they lacked the knowledge of mathematical language (Adetula, 1990). Many bilingual students struggle with mathematical terms, when they translate mathematical terms from English into their own language, because many mathematical terms do not exist in their primary language. For instance, Togan and Moan students had problems translating mathematical word problems into mathematical equations because some mathematical terms were undeveloped in their mother tongue (Latu, 2005). In addition, Lue Vang

(1988) mentioned that many mathematical vocabularies were undeveloped in the Hmong language such as “exponent,” “complex number,” and “square,” this has not been explored in the Hmong language.

Natural of Misconception

The natural misconception of mathematical word problems among bilingual students stemmed from them bringing their home language into the class. They did not prepare themselves to come to the classroom to learn new materials in English (Mestre, 1987). Bilingual students attempted to use both their primary and secondary languages when they learned new materials, and when working on mathematical problems in the classroom (Moschkovich, 2005). Bilingual students, especially Hispanic students, often did not look at the concepts and materials provided in the textbook because they did not understand the materials. They mostly used examples and other notes that the instructor provided during class as their reference. They would only open the textbook when they needed to complete assigned problems (Prin, 1998). In addition, when ELLs worked on mathematical word problems, they rarely understood the concept of the problem statement. They could not combine every word from the passage to form the appropriate mathematical equation (Neville-Barton & Barton, 2005). When bilingual students came across unfamiliar mathematical terms, they would have a hard time figuring out the meaning, preventing them from moving forward with the word problem. They could not tell whether or not the difficult terms were necessary in connecting the whole passage to build the mathematical equation (Prin, 1998). Research revealed that the words used to

state a problem did not necessarily reflect the structure of the problem, but instead affected the comprehension and translation of the verbal statement (Adetula, 1990).

However, the English-speaking students and bilingual students, especially the Hispanic students, did not share the same common misconception in general (Mestre, 1989). On one hand, English-speaking students mistranslated the written language to algebraic language by writing the reversal equations (Rosnick, 1981). The misconception among Hispanic students, on the other hand, was semantic errors. For instance, in the problem below, English speaking students translated the problem statement into mathematical equation as $6s = p$ (Mestre, 1989). "Write an equation using the variables *s* and *p* to represent the following statement: There are six times as many students as professors at this university. Use S for the number of students and *p* for the number of professor." Monolingual students were confused and could not distinguish the difference between variable and label from the statement. English speaking students translated the variable *s* as students instead of number of students. Similarly, they translated the variable *p* as professor instead of number of professors (Rosnick, 1981). When they were confused about the variables and labels, they were thoughtless and careless about their translation. They would end up with the mathematical equation $6s = p$ by translating word by word from the passage straight from left to right. They did not plug in a specific value to check their mathematical equation to see whether or not their equation was correct (Gerace & Mestre, 1981). The variable and label was the main area of confusion that caused the mistranslation among monolingual students in general (Lochhead & Mestre, 1988).

However, the reversal error appears not simply due to carelessness but rather to a self-generated, stable, and persistent misconception concerning the meaning of variables and equations. The concepts of variables and equations are fundamental, and it is difficult for students to practice and understand their mistranslation (Clement et al, 1981). For instance, in the problem of students and professors stated earlier, Hispanic students translated the verbal statement into mathematical equation as $6s = 6p$. They mistranslated the phrase “as many students as professors” from the verbal statement (Clement, 1981). The Hispanic students translated the phrase “as many students as professors” by referring to both students and professors, so both students and professors were equal. Moreover, still many Hispanic students translated the written language of students and professor into algebraic equation as $6s + p = t$ (Mestre, 1989). The mathematical equation expressed the relationship between students and professors to the total of students and professors (Mestre, 1983). The difficult words from the problem caused the Hispanic students to misunderstand the relationship between variables (Prin, 1998).

When comparing mathematical word problems written in an English translation and mathematical performance between English speaking students and Hispanic students, the results indicated that Hispanic students were falling behind the English-speaking students due to significant factors. One possible factor is that the Hispanic students came from low-income families and lived in poor neighborhoods (Mestre & Gerace, 1981). Another component is that the Hispanic students came from family’s that lacked education (Baum & Flore, 2011). Many Hispanic students were first-generation college students. Their parents lacked an educational background, as well as

not being high school graduates (Swail, Cabrera, & Lee, 2004). Many Hispanic students did not receive advice from parents and other sources, such as counselors and other educators, to pursue college degrees (Mestre & Gerace, 1981).

The Hispanic students, in addition, would spend more time translating mathematical word problems into mathematical symbols, and required more time to solve mathematical equations than non-minority students (Mestre, 1983). According to Mestre and Royer (1988), Latino students would take a guess, and risk the chance that their answer was translated into a correct mathematical equation. Language proficiency, in addition, affected the Hispanic students' schooling status. They lacked proper knowledge of language skills, so misinterpretations were common when translating written language into algebraic language (Mestre & Gerace, 1981). This indicates that language is an issue to bilingual students because many mathematical terms have not been developed in their mother tongue, and the complexity of mathematical phrases is adding yet another challenge to the bilingual students (Latu, 2005).

Strategies to Support Students Overcome Misconception

In order to support bilingual students to overcome mathematical misconceptions, teachers need to understand the students' background, their socialization outside of school, and how the student works daily outside of school (Lester, 2007). Additionally, teachers need to guide their students in discussion when students attempt to solve mathematical problems. This strategy will guide students on how to come to a mathematical solution. It also provides a hint for the students to express their learning and be able to write mathematical equations to represent the problem statement (Mestre,

1989). Instructors, in addition, need to provide more verbal direction to students during class time to help students understand concepts. The discussion between teachers and students will influence students to comprehend the procedure in solving mathematical problems (Gerace & Mestre, 1981). Since mathematics is the universal language of science and technology, many mathematical terms are new and unfamiliar to the students (Reyes et al., 2008). Teachers will need to introduce each mathematical term slowly to students, so the students can comprehend the meaning of mathematical terms (Robertson, 2009). Moreover, teachers need to introduce computer technology and graphing calculators into the classroom, so students can be familiar with the new technology. When the students grow up, they can become comfortable using the technologies along with the cultural traditions that their parents practice daily (Lester, 2007)

According to Ahmad and Goolamally (2010), positive learning environments are important to students. It builds the students' self-confidence, so the students can concentrate on learning the materials provided by the teacher during class. Also, students will learn to trust the teachers; therefore, taking advantage of working on the mathematical problems that the teacher assigns. Moschkovich (1999) mentioned that teachers who had high expectations and were free of judgment would help diverse students to take a risk and challenge themselves to learn the new materials. Also, allowing sufficient time for students to ask questions is beneficial to the students because they are given an opportunity to clarify what they misunderstood from the in-class lecture. Ernst-Slavit and Slavit (2007) also mentioned that teachers needed to know the students' backgrounds in order to provide quality service and appropriate instruction to support and fix the needs of students. Teachers need to consider putting students into

groups and allowing them to use their primary language within the group, allowing the students to learn from each other (Moschkovich, 1999).

The peer-tutoring method also supports the students' comprehension of materials from class. It especially helps students learn English as their second language. The peer-tutor method improves their academic performance in school because the students are able to communicate effectively amongst one another (Lyttle, 2011). For instance, the dual language program and Spanish Immersion Program helped the Spanish-speaking students perform better on reading, writing, and math in the classrooms compared to other Spanish-speaking students who just attended the regular classrooms (Egan, 2007). Similarly, the Hmong language introduced in school either as an after-school program or during regular class sessions has improved the Hmong students' self-esteem and made the Hmong students want to participate in classroom activities (Priote, 2008; Candace, 1992).

Home Language Supports Bilingual Students to Learn the Terms

Many studies in the past found that introducing the home language in the classroom supported bilingual students, improving their academics. Home language, in addition, was a bridge to build the foundation of reading and writing in English. If school did not include the home language in school, students would be at a disadvantage in succeeding in reading and writing tasks (Gay, 1988; Snow, 1992). In a recent study by Walsh and Tribune (2003), Hmong students who learned their own language in school improved their academic performance, as well as giving them a convenient way for the Hmong students to communicate to their parents at home. Hmong students were

interested and excited to take a Hmong class in school, if offered, rather than other Southeast Asian classes such as Thai, Filipino, or Vietnamese (Heather, 2007).

According to Moschkovich (1999), bilingual students who used their own language to interpret written materials in English during class time improved their understanding of the concepts of the materials more than just interpreting the message into English. The code switching between the two languages, the second language to first language of bilingual students, indicated a useful tool for bilingual students to get their work done, and it also showed a significant result of improving bilingual students' school performance. In New Zealand, the teachers' explanation of mathematical concepts and terms in both the Samoan language and English language during class helped the Samoan students to understand the mathematical concepts better than the teachers only teaching the mathematical concepts in English (Latu, 2005). Also, the Hmong dual language program in St. Paul, Minnesota, indicates that Hmong students improved their English vocabulary more than other Hmong students that were taking regular classes. The Hmong dual language program developed stronger academic skills, demonstrated greater academic gains, and students became more proficient in both languages, English and Hmong. The Hmong students were able to maintain their own language and culture (Xiong, 2011).

Summary

Many studies in the past indicated that a student's misconception of mathematics was due to language issues. It was not only bilingual students who mistranslated mathematical word problems into algebraic equations, English-speaking

students also made mistranslations. Mathematics is a universal language, but it is difficult for students to understand the general concepts and terminology.

In order to support students to overcome mathematical misconceptions, many researchers suggested that teachers need to provide positive learning environments, guide the students in discussions, provide more verbal directions to clarify the concepts, set a high expectation and be free of judgment of the students' learning styles, allow ample time for students to ask questions, get to know the students' backgrounds, put students into small groups to have discussions in their own language, and use the peer-tutor method to support students to learn. These strategies are very important to both teachers and students because it can influence students to overcome difficulties that they face in school and also allow teachers to provide a higher quality service for their students.

In addition, many researchers stated that introducing home language in the classrooms helped bilingual students improve their English vocabularies and school performance. The Spanish dual language program and immersion program helped the Hispanic students increase their academic areas in math, reading, and writing more than those that studied in the regular classrooms. Also, the Hmong dual language program was another example that supported the Hmong students by increasing their English vocabularies while maintaining their culture and language, so they could still communicate with their parents at home.

CHAPTER III

METHODOLOGY

Sample

This is a case study of a Hmong student learning mathematics in school. The researcher selected a Hmong student at Butte College to interview about his or her educational experience, but the researcher was focused mainly on the student's mathematical learning experience from previous levels up to the college level. The student that the researcher chose to interview was able to read and write Hmong because the Hmong language was an important part of this research study. The researcher was interested in how the Hmong language played a part of this Hmong student's educational experience, especially mathematical learning experience.

Instrumentation

This was a qualitative case study of a Hmong student's educational experience, focusing specifically on the student's mathematical learning experience. The researcher designed a questionnaire relevant to the student's educational experience to use in interviewing the student. There were a total of 40 questions that the researcher asked the interviewee, and the questionnaire consisted of several sections. The first section of the questionnaire was about the student's background. The second section of the questionnaire was about the student's educational experience in elementary school.

The third section of the questionnaire was about the student's educational experience in middle school. The fourth section of the questionnaire was about the student's educational experience in high school, and the last section of the questionnaire was about the student's educational experience in college. Each section had follow-up questions, since some responses from the interviewee might not be clear to the researcher, or might interest the researcher. Therefore, the follow-up questions were constructed by the researcher based upon the initial responses, to obtain more information on how the student felt about his initial responses, mathematical performances, or mathematical translations.

In addition, the researcher created mathematical phrases for the student to translate into mathematical symbols, and the researcher also created mathematical word problems for the student to translate into mathematical equations and then solve. Some of the mathematical problems that were provided to the student to do during the interview came from a topic that the student struggled with in the past. Some of the mathematical problems were created purposely by the researcher, not related to any difficult topics in the student's past. This was to determine how the student translated the word problems into algebraic notation, and handled the problems.

The researcher also observed the student in the class to gain information about how the student acted, interacted, and behaved during class time. The information from the observation was used to support what the student disclosed during the interview. The researcher also used the information from the observations to create mathematical word problems for the student to do during the interview session.

Additionally, the researcher designed another portion of the questionnaire to interview the student's parents to obtain information about their educational experience. There were a total of five questions that were used to interview the parents, and all the questions were considered as short answer, opened ended questions. There was no follow-up questionnaire.

Data Collection

During each interview, the researcher used audiotapes to record the student's responses to each question. The researcher also wrote down some important notes on ideas that the researcher could use as reference in the future if anything was missing or needed. On few occasions, the researcher used a camcorder to record the student's mathematical performance when the student performed mathematical problems on the board. The researcher also applied protocol-interviewing methods to reveal more information about how the student performed mathematical problems. The researcher would ask the student to explain about his solving procedure, what strategy or strategies he used to approach the mathematical problems, and so on, in order to make sense about how the student thought about the problems (Lodico, Spaulding, & Veogtle, 2010).

The combined interviews lasted nearly eight weeks, and each interview was performed on the Butte College main campus. In order to gather all pertinent information from the interviewee, the student and the researcher would meet three times a week, and each interview was roughly about an hour long. In addition, in order to collect more information about the student's background, the researcher also conducted a mini-interview with the student's parents regarding their educational experience, how they

supported their children regarding school activities, and their expectations of the interviewee. All the information collected from the parents was used to describe and support ideas related to the student's mathematical learning and performance.

Data Analysis

This was a qualitative case study of how a Hmong student learned mathematics in school, so the researcher often analyzed the data right after each interview session was complete (Hancock & Algozzine, 2006). The goal for the analysis of the data was to search for "connecting threads" and "patterns" from the data to create a meaningful picture based upon a Hmong student's educational experience. Also, the researcher could refer to the data to construct appropriate follow-up questions to pursue more information from the student, if any interesting points existed. After all data had been collected from the interviews, the researcher transcribed the information from audiotapes, camcorder, and notes into Hmong. The researcher would then translate the transcript into English because this Hmong student responded to all questions in the Hmong language during the interview. After the data was translated and organized, the researcher interpreted the data. The goal of the interpretation of the data was for the researcher to understand the connection between the data, and for the researcher to draw a conclusion.

In addition, the researcher analyzed the data and assigned letter codes to separate the data into categories (Fernandez, 2003). The information from the different categories served a few purposes. First, the researcher would use the information from the categories to construct concept maps to describe the relationship of each idea the

researcher discovered in the data. Second, the researcher would turn the information from the categories into percentages to describe the situations that occurred from the data. These situations ranged from what role the Hmong language played in this Hmong student's mathematical learning experience, what kinds of mathematical word problems this Hmong student got correct, etc. The following section presents the categories that were inductively constructed through data analysis.

CHAPTER IV

RESULTS AND DISCUSSION

Overview

This chapter is divided into six sections. The first section is about the student and his family background; the second section is about the student's educational experience and learning motivation; the third section is about the student learned mathematics; the fourth section is about language issues; the fifth section is about mathematical errors; and the last section is about the student's approach on mathematical thinking.

Student and Family Background

According to the data collected from this Hmong student, he was born in 1993 in the Refugee Ban Napho Camp, Thailand. His father completed the sixth grade in the language of Lao, and his mother completed third grade in the language of Lao during their residence in the refugee camp. When the Thai government closed the camp in 1996, his father moved his family to the United States when this Hmong student was just three years old.

When they arrived in the United States, his parents did not continue their education, so restricting their knowledge of the English language. His father worked as a janitor to support the family, while his mother was a stay home parent who took care of

his grandma, the children, and the household. This Hmong student started school two years after he arrived in the United States at Poplar Avenue School in Oroville, California. He attended kindergarten through high school and graduated from high school in June of 2011. Thereafter, he transferred to Butte Community College and volunteered to participate in this project during his first year in college.

Student Educational Experience and Motivation

In the previous section, the researcher was introduced about this Hmong student background. In this section, the researcher will explain about this Hmong student educational experience and motivation. According to this Hmong student, the best time to practice and studied was when he stayed home alone because there would be minimal distractions. He would study and practice his old homework assignments and in-class activities until he felt confident with the mathematical solving steps and became familiar with some of the mathematical terms. He spent about two to three hours practicing between 30 and 50 problems each time. This Hmong student was a flexible, cheerful, and happy student. He had a positive attitude toward going to school. The participant said, “To me, embarrassment, disciplinary, and others’ judgment, I just thought that it was a way of teaching me. I put it in a good way to empower me to keep studying hard in the future.” He would turn everything against him into a positive outcome and a source of energy to support his learning.

Another source of energy that supported this Hmong student to continue his learning was motivation. Motivation gave him the determination to perform well both in school and in life. The participant identified five roots of motivation that inspired him to

continue his education, especially in mathematics such as parents' support, people's admiration, desire to compete successfully in classroom, interest in assisting others, and desire to be a role model for younger siblings as indicated on figure 1.

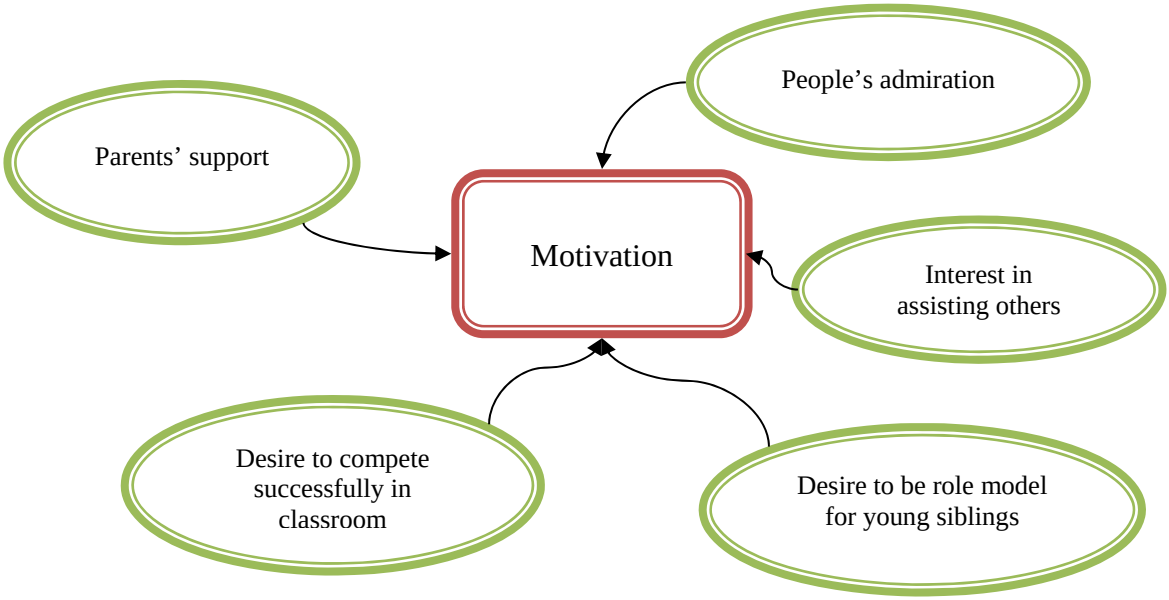

Figure 1. Student's motivation of learning mathematics.

Parents' support was very special and crucial to the subject. His parents supported him by praising him on his hard work, supplied him with materials and transportation, gave him allowance to spend wisely, and provided food for him at home. Although his parents could not assist him on his school assignments, they supported him by staying up with him every night until he finished his homework, and then everyone would go to bed whether it was very late or not. Plus, his parents would console him with words such as "keep trying it and you can do it" while he struggled with his schoolwork. The words from his parents encourage him to work even harder and not give up even when his homework proved difficult. His parents would drive him to his friend's house to

get ideas from them when he sought further assistance. These gave him the motivation to do well in school so his parents and everyone would be proud of him.

The second motivation that influenced this student's learning was people's admiration. It was like a big prize and a source of energy to this student to want to continue to work hard on school activities, especially in mathematics. For instance, when the student was in fifth grade, he was taking sixth grade level math because he scored high on the School Math Assessment Test. His uncle was proud of him, so his uncle told his own children that they needed to be like him and use him as an example to follow. According to the subject, he said, "I also wanted other people to admire me that I was only in fifth grade, but I could carry the sixth grade level math book. This was one of the energy that supported me for not give up too." The subject continued to say, "I wanted all the parents to see that I am a Hmong student that was very smart, and I also wanted all my friends to know that I was smart." This gave the participant the motivation to work even harder because someone like his uncle was acknowledging his hard work in his math class.

The third motivation that helped influence this student's learning in mathematics was the desire to compete successfully in classroom. The participant liked to compete with other students in his math class. He liked to be the top student in the class because it made him feel good about himself. For instance, the participant went to school every day because he wanted to earn perfect attendance where some students could not. He studied and worked so hard on his tests and schoolwork because he wanted to earn first place in his math class. According to this Hmong student, he wanted other students, parents, and friends to notice and respect that he was a "brainy" student. He did not want

any other student in his math class to be ahead of him. If any student in his class was ahead of him, this particular student would study even harder until he caught up with that student or be ahead of that student. The student said in the interview, “As for learning or anything about school, I liked competition the most. I always thought that I must try my best to be the first all the time, so other students could just get second place.” To be in a competition, to this Hmong student, was an achievement and a prize to gain, this motivated him to strive for success in school.

The fourth motivation that helped support this student’s learning in mathematics was an interest in assisting other people. This Hmong student dreamed to help and serve other Hmong people in the Hmong community, and he even dreamed to pursue his education in order to provide high quality service to the Hmong people. He said in the interview, “I am proud that even though I cannot help many other people; I can help my family and my aunt’s family by interpreting for them. It makes me happy that I need to continue to study hard for school, so I can help other people besides my family and my aunt’s family in the future.” At school, he helped his classmates on their homework who struggled with math. This helped him to practice his math skills. He even helped his brothers, sisters, and cousins to do their math homework when they needed help. While at home, he helped interpret for his parents and cousins when they went out to places like stores, clinics, or hospitals. For example, he went with his aunt to the hospital to interpret for his aunt. The participant wanted to set an example for his family and relatives to follow. No one in his family or in his aunt’s family knew how to speak English. Regardless of his competitiveness, this student assisted other students in his

math classes and assisted his siblings and cousins at home with their homework. He wanted to set a good example for others to follow.

Lastly, the fifth motivation that helped support this Hmong student's learning in mathematics was the desire to be a role model for his younger siblings and cousins. When the subject was in fifth grade, he was a good role model for his siblings and cousins. He turned in all his homework on time. He listened and followed directions in class and at home. He helped interpret for his families and relatives. Since he was doing so well in school, one of his uncles introduced him to his two cousins.

The uncle was pleased that the participant was already taking sixth grade level math, so the uncle told his children to be like the interviewee. The uncle told his two children to work hard in school and help around the house. In addition, this Hmong student wanted to be a good role model for his other cousins, his aunt's children, because they just arrived in the United States from the refugee camp in Thailand. This Hmong student studied hard in school to show his younger siblings and cousins that education was very important for them. Therefore, in order to accomplish any goal in the future, they needed to attend school and work hard in school. In the interview, the student said, "My aunt and her family were coming to Oroville, so I must work hard to be a role model for my cousins, so they could rely and get assistance from me." This showed that he was a role model for his family and cousins to have a better life style.

From the result above, it is reasonable to conclude that parents' support, people's admiration, and student's high expectation on certain goals were very important for the student to reach his or her future dreams. As for this Hmong student, parents' support, people's admiration, desire to compete successfully in classroom, interest in

assisting others, and desire to be a role model for younger siblings motivated this Hmong student to continue his schooling, and it played a big role in this Hmong student educational academic success. These varieties of motivation were influenced this Hmong student for not to give up on school works. Instead, these varieties of motivation were a source of energy and a big prize to this Hmong student to stride hard to do well in school especially in mathematics. Nevertheless, it is difficult to predict whether these types of motivation were stemmed from the Hmong culture, or it was contributed to this Hmong student personal belief. The data collected from this Hmong student was not enough evidence to support that motivation was tied to the Hmong culture or an individual. The researcher would suggest that more research is needed to study about how these varieties of motivation play a role in the Hmong students' educational experiences.

How Student Learned Mathematics

In the previous section, the researcher discussed about this Hmong student educational experience and motivation. In this section, the researcher will further mention about how this Hmong student learned mathematics. According to this Hmong student's response during the interview, he often mentioned that he learned mathematics in school by example, practice, and memorization as shown in Figure 2.

The examples provided by the instructor during class time were important to him because he could see every step in solving mathematical problems. The student would memorize the steps and apply them to solve other mathematical problems. The subject stated in the interview, "I think the examples help me the most because it shows every step for me to look at. When I remember the steps, I can use it to do other similar

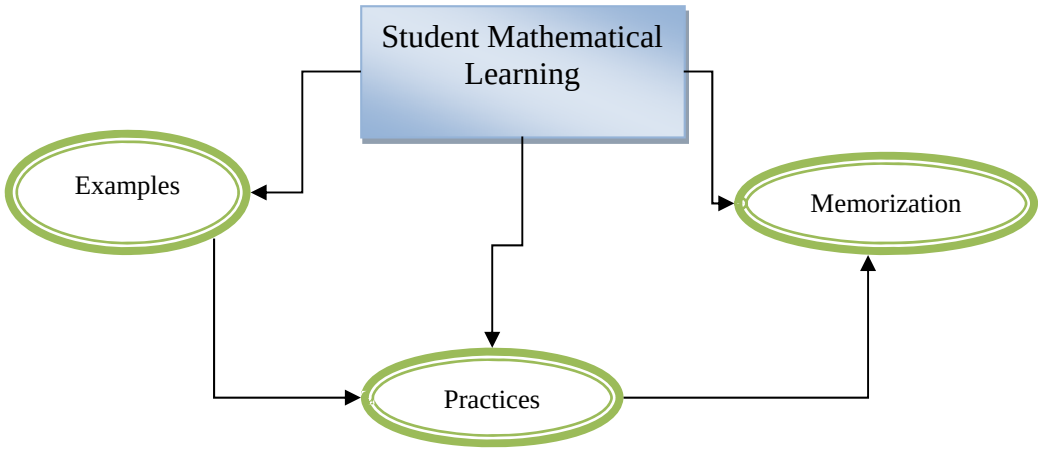

Figure 2. Student's approach to learn mathematics.

problems." For instance, when this Hmong student worked on his math homework and had difficulty with the homework, he would refer to the examples demonstrated in class to help him solve other math problems. Most importantly, by practicing other problems using the solving steps from the examples, this Hmong student could memorize the steps in solving equations and some mathematical terms that were unfamiliar to him, so it would help him to get ready for the in-class quizzes and tests.

In order to memorize all the solving steps and many mathematical terms, this Hmong student would spend two to three hours a day to study old material such as homework, class activities, and other assignments. As the subject said during the interview, "Some mathematical terms that do not have Hmong words, I use memorization and practice to learn those terms."

The subject further said, "You just practice until you memorize. If you don't practice, you cannot memorize, so this is the biggest strategy that I use to help me to learn." There are limited Hmong words in the math context. For instance, the subject

said, “Fraction must mean one number over another number. I memorize just like that.” The subject, in fact, did not practice to understand the concept of fraction. Instead, he practiced to understand and memorize how to write a fraction. Nevertheless, it is reasonable to state that example, practice, and memorization were all important learning strategies for this Hmong student, and it contributed to this Hmong student’s school accomplishments, especially in mathematics.

When this Hmong student worked on his mathematical homework, he would often check his answer to make sure that his answers were correct. One of the ways he checked his mathematical answers was by looking at the back of the book when he worked on the odd number problems. Another way to check his mathematical solution was to plug-in the solution back into the original problem or equation to see if the answer turned out correctly. The third way this Hmong student checked his answer was by gauging his feeling toward the answer. For instance, in the problem, “The product of two consecutive even integers is ten less than five times their sum. Find the two integers,” the subject translated the problem statement into $x(x+2) = 5x - 10$, and he got $x^2 - 3x + 10 = 0$ after he simplified and combined all like terms. The subject felt that his algebraic equation might be incorrect because he could not factor the equation. He corrected his initial translation by translating the problem again, so he got another algebraic equation such as $x(x+2) = 10 - 5x$. After he simplified and combined all like terms, he got $x^2 + 7x - 10 = 0$. The participant felt that both equations were incorrect, and he didn’t take either one to be his final equation to solve to get the answer because both equations could not factor.

Obviously, this was reasonable to say that this Hmong student was cared about his solution because he liked to compete with other students, so he would verify all of his answers to make sure that his answers were correct. However, it didn't mean that he would get all correct answers if he checked his solutions after he completed the problems. Sometime the mistake was occurred from translation between word problems and algebraic equations instead of misapplying the solving technique to solve the equations as discussed earlier.

Language Issues

In the previous section, the researcher discussed the student's approach to learn mathematics. In this section, the researcher will explain why language is an issue for this Hmong student. According to the data collected from the interview, this Hmong student lacked the expertise in English to translate between mathematical word problems and algebraic symbols. For example, when this Hmong student translated a mathematical word problem into an algebraic equation, he was not able to define whether his translation was correct or not until he spent time to solve the equation as we discussed earlier. This was possibly that the participant did not know a sufficient amount of the English language. Sometimes he understood all the words from the passage, but he would not understand the main idea of the passage. Since English is his second language, this contributed to the difficulty of translating between mathematical word problems and algebraic notations.

Another issue for the participant was that his parents were not able to give advice and support him on his mathematical translations between mathematical word

problems and mathematical symbols because they did not speak English. Also, they did not have much of an educational experience. The other issue is that the Hmong people did not have a writing system before 1950. They used verbal communication and memorization to send messages from person to person and from village to village (Vang, 2011). They also did not have a system of formal education until they settled in the United States (Lor, 2008). A survey by West Coast conducted in 1982, showed that 70 percent of the Hmong population during that time in the United States had no education (Pfeifer, 2004). The Hmong parents were not able to advise their children about education because they lacked the educational background (Vang, 2005).

In addition, a big factor that was reasonable causing the interviewee a difficulty in translating mathematical word problems into mathematical notations was that there are no grammatical rules and punctuation conveyed in writing and communicating in the Hmong language. According to Wyne (2005), the Hmong language is a contextual language. There are no plural nouns in the Hmong language. The Hmong people just use numbers to represent anything greater than one. For instance, “Kuv muaj tsib tug npua” translates literally to “I have five pig” The Hmong language does not have “*s*” to infer something more than one as in English.

The Hmong language is the language written and read from left to right and translated word by word from left to right (Bliatou et al, 1988). For instance, “koj ua dabtsi” in Hmong translates to “*what are you doing*?” However, if translated literally, “koj ua dabtsi” means “you do what.” The first word to the far left is the leading word, followed by the second word to the far left and the pattern continues until the last word on the far right. Each word from the passage connects and relates to one another. The

Hmong people do not have objective pronouns, reflexive pronouns, or possessive pronouns in their language. They only have subjective nouns such as I, you, we, they, and he/she/it. For instance, “I love you, and you love me,” translates to “kuv hlub koj thiab koj hlub kuv.” “Kuv” is used for both of the terms “I” and “me.”

The Hmong language does not consist of past, present, and future tense. If a Hmong person talks about something in the past or future, he or she just refers to the time (Xiong, 2008). For instance, “koj ua dabtsi nag hmo” translates to “what did you do yesterday?” In literal terms, it would be “you do what yesterday?” In addition, “koj ua dabtsi lwm hnub” in Hmong means “what will you do in the future?” in English; however, if translated word for word from Hmong to English, it would be “you do what future?”

According this Hmong student’s description of his educational experience and his response during the interview, he stated that the word problems written in English were difficult to understand because there were many words in English that mean one thing in Hmong. In some cases, the word problems written in English were not translated straight from left to right as in the Hmong language, so it created a more complex task. We will take a look at how this Hmong student translated mathematical word problems into algebraic symbols and how language issues existed during his translation as follows.

There were a total of 31 mathematical word problems that were given to this Hmong student to complete during the interview. These mathematical word problems consisted of both languages, English and Hmong. The total numbers of mathematical word problems written in Hmong were eight, and the total numbers of mathematical word problems written in English were 23. The percentage of correct answers from both

versions was 64.5%, and the percentage of incorrect answers from both versions was 35.5% as indicated on Figure 3.

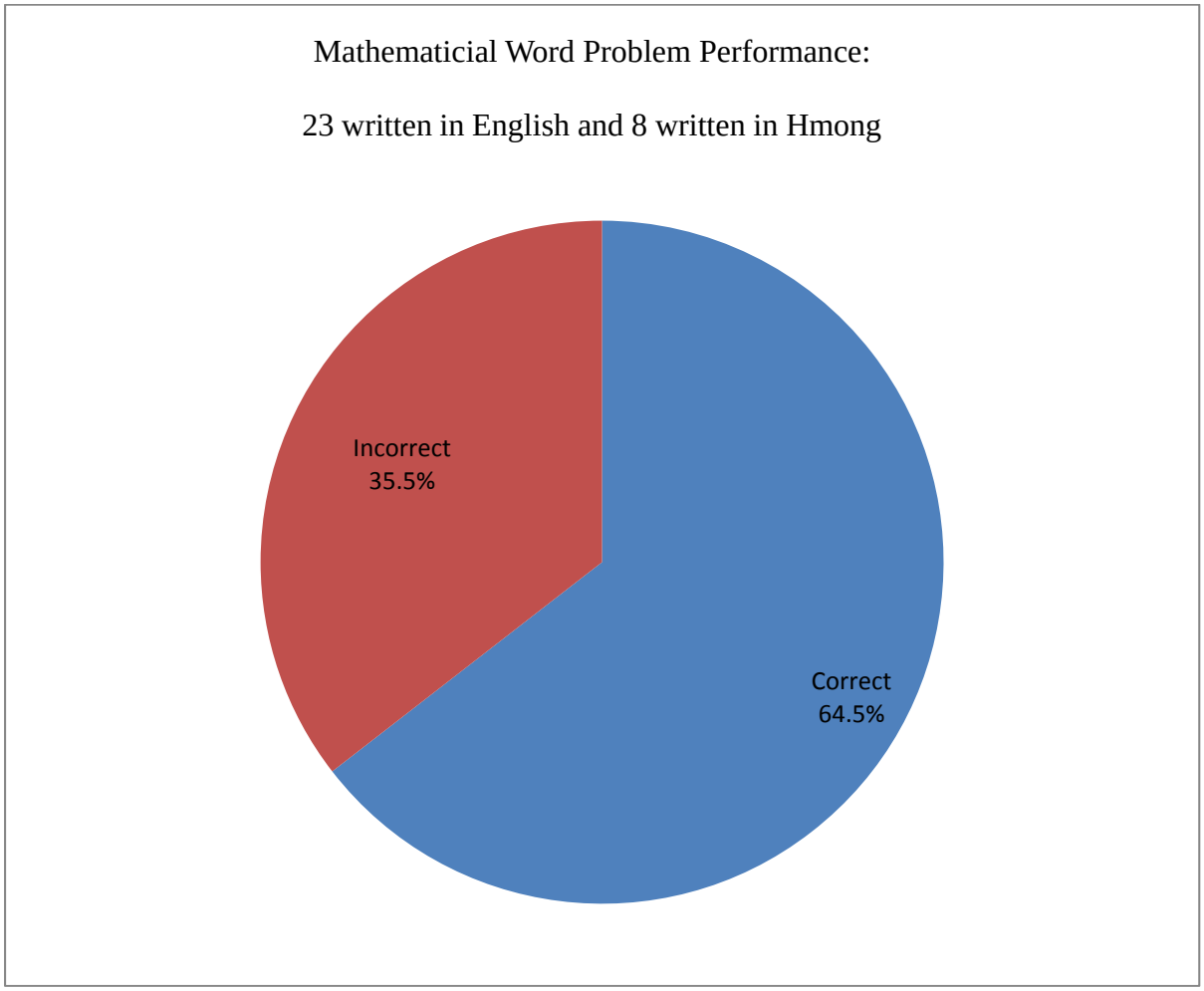

Figure 3. Student's mathematical performance.

The result from Table 1 indicated that this student got 8 out of 8 mathematical word problems written in Hmong correct and got 12 out of 23 word problems written in English correct. The total of mathematical word problems that the subject got correct was 20 out of 31. These mathematical word problems came from left to right translation

Table 1

Result of Student's Mathematical Performance

Interview Session #	L-R Hmong Language	L-R English	Simple Language in Hmong (L-R)	Simple Language in English (L-R)	Complex Language in Hmong	Complex Language in English
4th		4 correct		1 correct, 4 wrong		
14Th		2 correct				1 wrong
15th		2 correct, 1 wrong		1 wrong		
16th	3 correct					1 wrong
17th	4 correct	1 correct	1 correct	1 correct		2 wrong
18th					1 correct	1 wrong

Notes:

- Percentage of all word problems done correctly is $\frac{20}{31}$ or 64.5%
- Percentage of all word problems in Hmong done correctly is $\frac{8}{8}$ or 100%
- Percentage of all word problems in English done correctly is $\frac{12}{23}$ or 52.2%;
- Percentage of all word problems done incorrectly is $\frac{11}{31}$ or 35.5%
- Percentage of all word problems from left to right done correctly is $\frac{16}{20}$ or 80%
- Percentage of all word problems in simple language done correctly is $\frac{4}{20}$ or 20%
- Percentage of all word problems in complex language done correctly is $\frac{0}{11}$ or 0%

problems and simple language problems. The results revealed that $\frac{16}{20}$ or 80% of all mathematical problems that this Hmong student got correct required left to right translation and $\frac{4}{20}$ or 20% of all mathematical problems that this Hmong student got correct contained simple language. For instance, an example of mathematical phrase written from left to right is "thirteen divided by a number," and another example of mathematical phrase written in simple language is, "the sum of two numbers is thirteen. Their product is 40. Find the numbers." The result from figure 4 also showed that this

Hmong student did not get any mathematical word problems written in complex language correct.

It is obvious that this particular student understood mathematical word problems written in Hmong better than those written in English. Plus, he understood every word from the problem statement written in Hmong precisely. This is not surprising as Hmong is the language he uses every day, with his family, cousins, relatives, and other Hmong people. The Hmong language is written and read from left to right, and each word usually has only one meaning. The participant stated, “Because it says in Hmong language exactly like that, I can understand much better.” The participant was not only getting mathematical word problems in Hmong correct, but he was also getting almost all left to right verbal statements in English correct as shown in Table 1. It is difficult to conclude whether the Hmong language or language structure (the structure of left-to-right) was the key to allowing the student to make the mathematical translation. It is obvious, however, that both language structure and the Hmong language influenced this Hmong student’s mathematical translation and understanding. The combination of the Hmong language and the left-to-right structure helped this Hmong student understood the mathematical word problems.

According to this Hmong student’s mathematical translation from the interview, he would translate the word problems into Hmong language first, and then he would translate one more time from Hmong language to mathematical symbols. He only translated those mathematical terms that are not existed in Hmong straight from English to algebraic. As the participant said,

> When I performed mathematical problems whether it was fraction or not, I always thought and used Hmong language to involve because Hmong language was the language that I used since I knew how to speak. It stuck in my mind all the times, so whether I thought or did something, I always thought in Hmong and then would translate into other languages such as English. In addition, if speak in Hmong language, it helps me to understand, and it is not too difficult.

See Figure 4 and Figure 5.

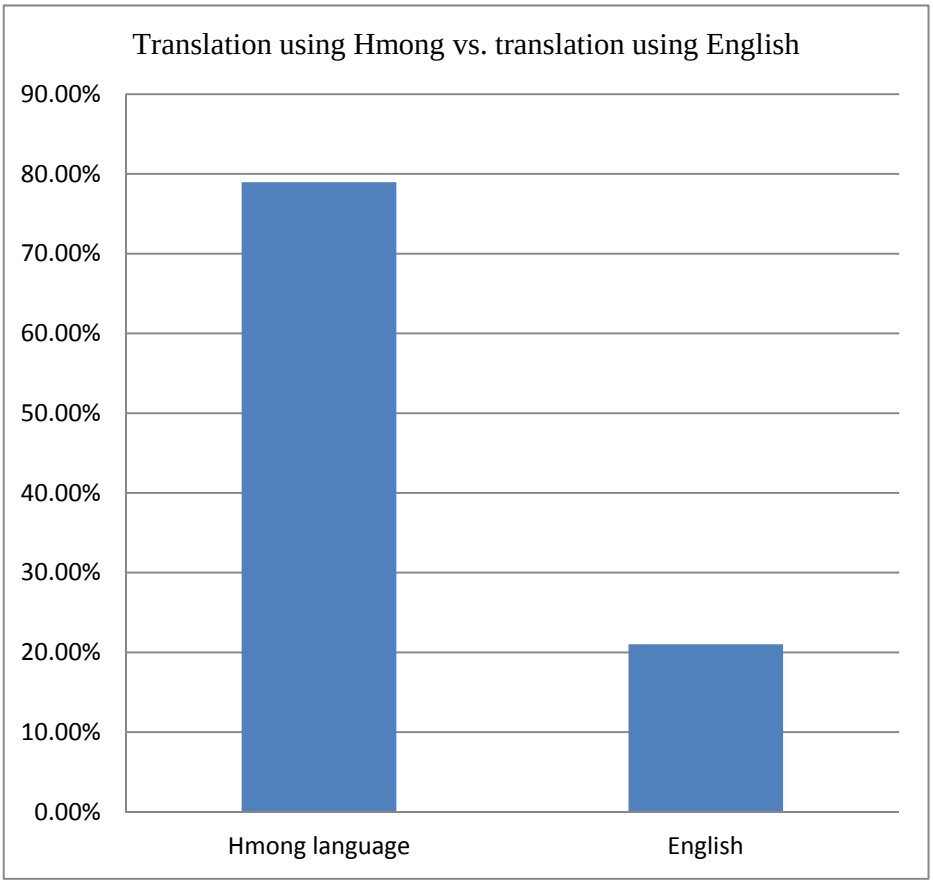

Figure 4. Hmong language translation vs. English translation.

In addition, when he translated the written language into algebraic notation, he preferred translating straight from left to right as indicated in Figure 6. For example, in the mathematical phrase, “twenty divides a number,” the subject wrote $20 \div x$. The subject said that there is a word in Hmong for “divide,” so “twenty divide a number”

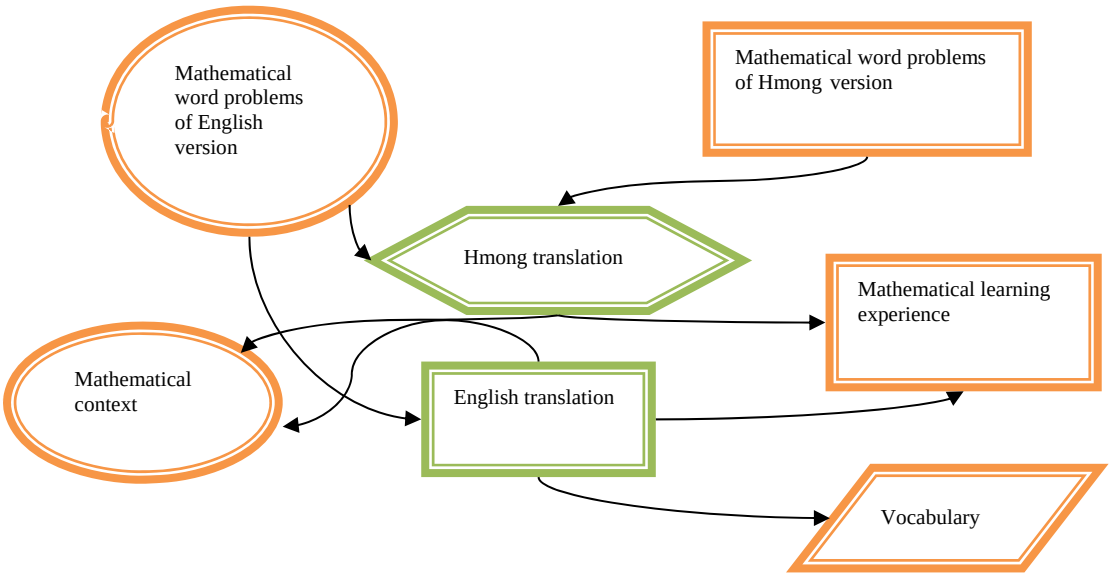

Figure 5. Student's mathematical translation using Hmong language.

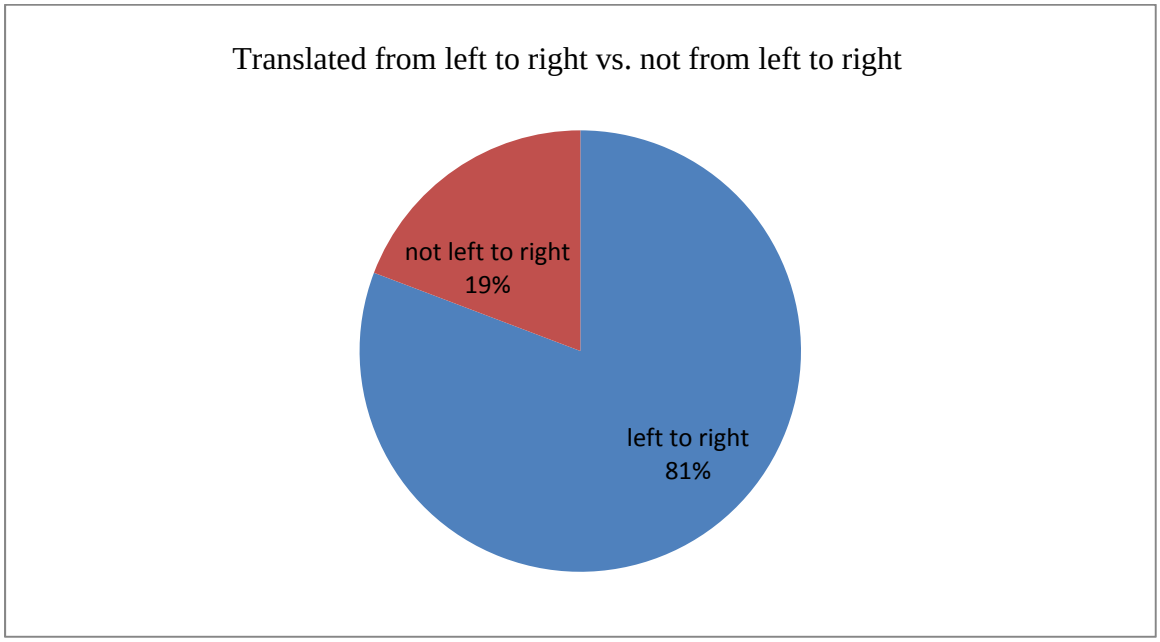

Figure 6. Translated from left to right vs. not translated from left to right.

meant $20 \div x$ to him. The subject used the variable *x* to indicate the unknown number, and he translated straight from left to right.

Similarly, when the participant translated the mathematical phrase, “two less than a number,” the participant said that “less than” means very small or little in Hmong, so “two less than a number” means $2 < x$ in mathematics to him. The participant used the mathematical inequality symbol to indicate that *2* is smaller than *x*. Furthermore, the participant continued to mention that the word “less than” also means subtract in English or mathematical language, so “2 less than a number” means $2 - x$. He used his prior knowledge from his learning experience to translate the phrase “less than” to get the correct mathematical operation, but he ended up with a reversed algebraic expression because he translated straight from left to right.

Another example is when the participant translated the similar mathematical phrase, “two more than a number,” in mathematical symbol. He said that the word “more than” means multiply because “more than” means “a lot” in Hmong language, so it produces very fast. Therefore, if it produces very fast, it is multiplication. The subject translated the written math into Hmong first, and then he translated one more time from Hmong to a mathematical expression to get $2x$. When the participant referred to his learning experience from class, he said that “more than” also means add, so he corrected his initial mistake by writing the algebraic expression as $2 + x$. The participant got the correct mathematical expression because addition is commutative, so $2 + x$ is equivalent to $x + 2$. However, the issue of getting $2 + x$ from this problem is exactly the same as the issue of getting $2 - x$ in the previous statement because it is translating straight from left

to right. These results indicated that the Hmong language was effecting this Hmong student's mathematical translation from mathematical word problems to algebraic symbols.

According to Vang (1988), mathematical vocabulary is undeveloped in the Hmong language. This is possibly the reason that the participant struggled with mathematical vocabulary when he translated mathematical word problems to Hmong language and from Hmong language to mathematical symbols. However, it is not only Hmong students that faced mathematical vocabulary issues. Other ethnic students also share common mathematical vocabulary issues. Latu (2005) mentioned that mathematical terms were not fully developed in Tongan and Samoan languages, and students struggled regarding mathematical vocabulary especially when students worked on mathematical word problems. Robertson (2009) also mentioned that mathematical vocabulary is an issue to second language learners because mathematical definition is different from common English definition, and also there may not be an equivalent word in other languages. Thus, English as second language students need help developing mathematical vocabulary in order to translate and perform well in mathematics.

Student Worked on Fractions

In the previous section, the researcher discussed about language issue for this Hmong student. In this section, the researcher will explain and summarize how this Hmong student worked on fractional problems. Based upon the data collection from the interview, this Hmong student often converted fractions to decimal or whole numbers before he solved the problems when he worked on fractional problems as indicated on

Figure 7. Occasionally, he might solve the fractional problems in fractional form if the problem was not difficult. According to this Hmong student, a fraction is interpreted as two numbers over each other, and there is no fractional word in Hmong language. It is difficult for him to memorize the terms and the steps in solving the problems. (See Figure 7).

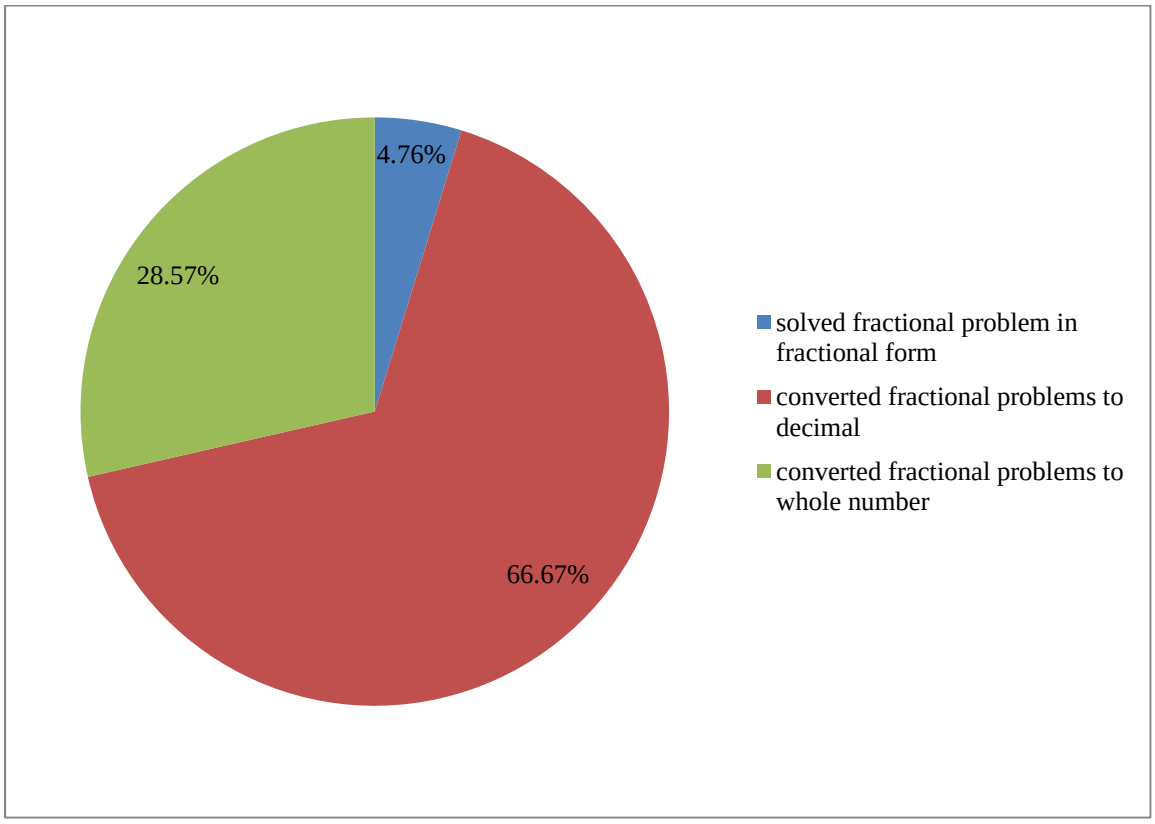

Figure 7. Percentage of student-solved fractional problems using different methods.

Operation with fraction, in addition, had more mathematical solving steps to memorize than decimal numbers and whole numbers computation. This contributed to the Hmong student having more of a chance to get incorrect answers if he solved the fractional problem in fractional form. For instance, in the mathematical problem, "$\frac{1}{2}$ is

bigger than $\frac{1}{3}$ by $\frac{1}{6}$. How do you say the fraction in Hmong?" this Hmong student said "1, 2 is bigger than 1, 3 by 1, 6"while many English speaking students would say "one-half is bigger than one-third by one-sixth." The subject borrowed the word "by" from English to use in Hmong because there is no Hmong equivalent. According to this Hmong student's response during the interview, when the Hmong people translated English to Hmong, they might ignore the word "by," or they might pronounce "by" as indicated in English. Furthermore, Hmong people translate the word "by" to refer to anything that is very close or relate to the situation that they want to describe.

In Hmong, there is no first, half, third, fourth, fifth, and so on like in the English language. The expression 1, 2 that this Hmong student expressed in Hmong as mentioned above did not mean 1 over 2 in general. It meant one and two or twelve to other Hmong people because it did not have a specific sign indicating that 1, 2 was the fraction one over two in English. When this Hmong student spoke about fraction in Hmong language, it was difficult to determine whether he talked about fraction or whole number. In order to ensure that other Hmong people understood when he verbalized fraction in Hmong language, he needed to borrow the word "over" in English to indicate that he referred to fraction, or he might use exactly the word "fraction" instead. However, it is not surprised that this Hmong student borrowed English words to express a specific meaning in Hmong. The Hmong people already borrowed some words from other languages such as Lao and Thai to use in their language. According to Bliatout et al. (1988), the Hmong people borrowed the word *lat* (pronounce as late) for math, *kun*

(pronounce as khoon) for multiplication, and *xun* (pronounce similar as soon) for zero from Thai and Lao.

The subject further mentioned that many Hmong people who did not go to school would say that “1 3” is bigger than “1 2” if they looked at the phrase, because the Hmong people used the whole number as their numerical base. They do not have other forms of numerals. Since 3 is larger than 2 on the whole number system, this indicated that 1 3 must be bigger than 1 2. He continued to state that many Hmong people who attended school would say “1 2 is bigger than 1 3” because they learned about fractions in school. They remembered that if the top numbers of the fraction are the same, the fraction that has the smallest denominator is the larger.

Moreover, this Hmong student said that fraction and division were not the same in Hmong. He explained that fraction does not provide a specific way of how to divide because there is no fractional word in Hmong. Division, on the other hand, indicates an explicit way of how to divide because there is a divisional word in Hmong language. For instance, the subject said that the fraction $\frac{3}{4}$ and the division $3 \div 4$ were not the same because the fraction $\frac{3}{4}$ was the same as a pizza that cut into 4 pieces for three children, so each child would get a piece of pizza and still one piece of pizza was left over. As for the division: $3 \div 4$, it was the same as 3 pizzas that each pizza cut into 4 equal pieces for 4 children. Each child would get 3 pieces of pizzas. When the participant compared the result that each child got from the fractional and divisional problems, the children did not get the same amount of pizza. This revealed that the two mathematical concepts are distinct.

The subject continued to say that fraction is opposite of division if he drew the picture and talked in Hmong. The fraction $\frac{3}{4}$ was the same as the division $4 \div 3$. When he drew the pictures to represent the two problems, the results revealed the same. For instance, the fraction $\frac{3}{4}$ was like a pizza cut into four equal pieces for three kids, so each kid would get a piece of pizza and still one piece of pizza was left over. As for the division $4 \div 3$, on the other hand, were like four oranges that are given to three kids. Each kid would get an orange, but there was still one orange left over. The two pictures were identical, so the two mathematical problems were the same. He further said that picture was like the word problem to him, so it was difficult for him to understand the meaning of the picture. Even though he understood the meaning of one picture, he was not sure that he could apply the result to solve and understand the other pictures. This indication showed that pictures and diagrams did not support this Hmong student learning mathematics because he could not use pictures to describe the relationship between fraction and division. Instead, pictures and diagrams might create another level of complexity.

Mathematical Errors

In the previous section, the researcher discussed about how this Hmong student worked on fractional problem. In this section, the researcher will explain some mathematical errors that made by this Hmong student from some mathematical problems during the interview.

Based upon this Hmong student's mathematical performance during the interview, there are several types of mathematical errors that occurred during his

mathematical translation between mathematical word problems and algebraic symbols. One of the problems is with possessive pronoun. For instance, in the mathematical problem, “the sum of a number and ten times its reciprocal is seven. Find the number.” The participant said that the term “its” was referred to ten, so he came up with the algebraic equation $x + 10 \cdot \frac{1}{10} = 7 \implies x = 6$. The term “its” was referred to the incorrect position; the equation he got was also incorrect. Another example where the participant made the same error is when he translated the mathematical word problem “The product of two consecutive even integers is ten less than five times their sum. Find the two integers.” He referred the term “their” to 5, so he got $x(x + 2) = 5x - 10$. After he simplified the equation, he ended up with $x^2 - 3x + 10 = 0$, but he could not factor the equation. He tried to correct his initial translation and came up with another equation $x(x + 2) = 10 - 5x$. After he simplified and combined all like terms, he got $x^2 + 7x - 10 = 0$. The subject could not factor the expression in the equation either. He assumed that he made a mistake because the polynomials in the equations could not factor. However, he could not correct his mistranslation because he could not find where he had made the mistake. It is likely that this Hmong student struggled with possessive pronouns because possessive pronouns do not exist in the Hmong language as mentioned earlier.

Another possible problem is the ambiguity of words or the limited number of Hmong words. For instance, in the mathematical problem, “If a certain number is added to both numerator and denominator of the fraction $\frac{7}{9}$, the result is $\frac{5}{7}$. Find the number.” This Hmong student translated the passage into equation as $x + \frac{7}{9} = \frac{5}{7}$. after he solved the

algebraic equation, he got $x = -\frac{4}{63}$. According to this Hmong student, “a certain number is added to both numerator and denominator of the fraction” meant to add *x* to the fraction. He interpreted the term “both” as two or just two numbers, which referred to 7 and 9 of the fraction in this case. In addition, there is no specific Hmong word for fraction. The concept of fraction does not exist in Hmong language (Mather & Chiodo, 1994). For instance, to say the fraction, $\frac{1}{3}$, the native English speaking students would say one-third, but this Hmong student would said “one-three”, because he said that the Hmong people do not have the terms first, half, third, fourth, fifth, and so on. Plus, other sets of numbers such as negative numbers, decimal numbers, imaginary numbers, and so on does not exist in the Hmong language. The Hmong people relied on oral speaking and used the whole numbers to be their numerical base. Each individual whole number is counted as a number to the Hmong people. This might be the result that when this Hmong student faced other sets of numbers especially fraction, he struggled because he didn’t encounter such experience.

Another possible problem for this Hmong student is the use of repeating phrases. For instance, in the mathematical problem, “one number is two more than twice another. Their product is two more than twice their sum. Find the numbers.” The subject could not express an algebraic equation to represent the written statement. The subject said, “I read this problem, I can understand it, but not all of it, so I cannot put it together. I don’t know how to write the equation. It has many things together, so it confuses me and do not understand the word problem.” Several possible explanations might account for this Hmong student’s reflection. One of the possible explanations is that he might

have difficult time to understand to what the phrase “more than twice” referred. Since the phrase was repeated in the passage, it might create confusion for the participant because the same phrase was used in reference to two different quantities. The participant could not justify the phrase, and he could not come up with an equation after he read the word problem several times.

This same problem provides an example of how multiple issues might come into play. It is also possible that language was an issue to the participant because the translation from the written statement was not going straight from left to right like in the Hmong language. It went the other direction from right to left when one’s attempting to translate the statement, so the subject had a hard time trying to figure out the meaning of the passage. The participant mentioned, “it has many things together, so I cannot write all together.” In addition, the use of the possessive pronouns “another” and “their” may also contribute to the confusion as we discussed earlier. Plus, the term “twice” might cause confusion because the participant might translate it as two instead of two times. The term “twice” is a mathematical vocabulary, and many mathematical vocabularies were not developed in Hmong language as mentioned earlier.

Other possible issue for this Hmong student is distinguishing nouns. For instance, in the mathematical word problem, “You are working at a hardware store. There are four and one-third pounds of nails that need to be placed into small boxes. Each small box needs three-quarters of a pound of nails. How many boxes do you need? Are any nails left?” The student wrote, “$3\left(\frac{1}{4}\right) = \frac{3}{4} = .75;\ \ 4\frac{1}{3} = \frac{13}{3};\ \ \frac{13}{3} \div \frac{3}{4} = \frac{52}{9};\ \ 9\overline{)52} = 5.77;\ \ then\ .77 - .75 = .2;\ \ 5 + 1 = 6.$ 6 boxes thiab seem 2 tug.” Translation: “6

boxes thiab seem 2 tug”in Hmong language means “6 boxes and 2 nails left over” in English. This Hmong student wrote “four pounds and one-third of nails” means $4\frac{1}{3}$, and he converted the mixed number to improper fraction. Also, he translated “three-quarters of a pound” to $3\left(\frac{1}{4}\right) = .75$. He said that a quarter is equivalent to .25, and .25 is equivalent to $\frac{1}{4}$, so 3 quarters is the same as $3 \cdot \frac{1}{4} = \frac{3}{4}$.

In addition, the participant also chose the convenient way to solve the problem, so he didn’t write an equation represented the statement. However, he did not separate the amount of small boxes and the amount of nails that left over. Instead, he combined the amount of small boxes and the nail that left over together. This is the mistake that the participant made through the problem. When the subject got $\frac{52}{9}$ after he solved the problem, he didn’t convert the improper fraction back into mixed number,$5\frac{7}{9}$, and took the fractional portion of the mixed number to find the amount of nails that left over and kept the whole number of the mixed number, 5, to be the total amount of small boxes. He failed to recognize that a box needs to be a whole. This Hmong student thought that each value greater than .75 provided a box because a box allowed holding $\frac{3}{4}$ pound of nails. At the same time he thought that value that less than .75 was interpreted as the amount of nails that left over. According Gorgen Berglund (personal communication, July 23, 2012), this type of mistake is prevalent with many English speaking students and other bilingual students. He believes this is due to a lack of meaning given to numerical computations by the students.

Student Approaches to Mathematical Thinking

In this section, the researcher will explain the strategies that this Hmong student used to solve mathematical problems during the interview. Based upon this Hmong student's mathematical work, there were several types of approaches to mathematical thinking used by this Hmong student. He could use more than one type of solving strategies to solve a particular type of mathematical problem, and the following strategies were using by the participant to overcome mathematical problems as indicated on Figure 8.

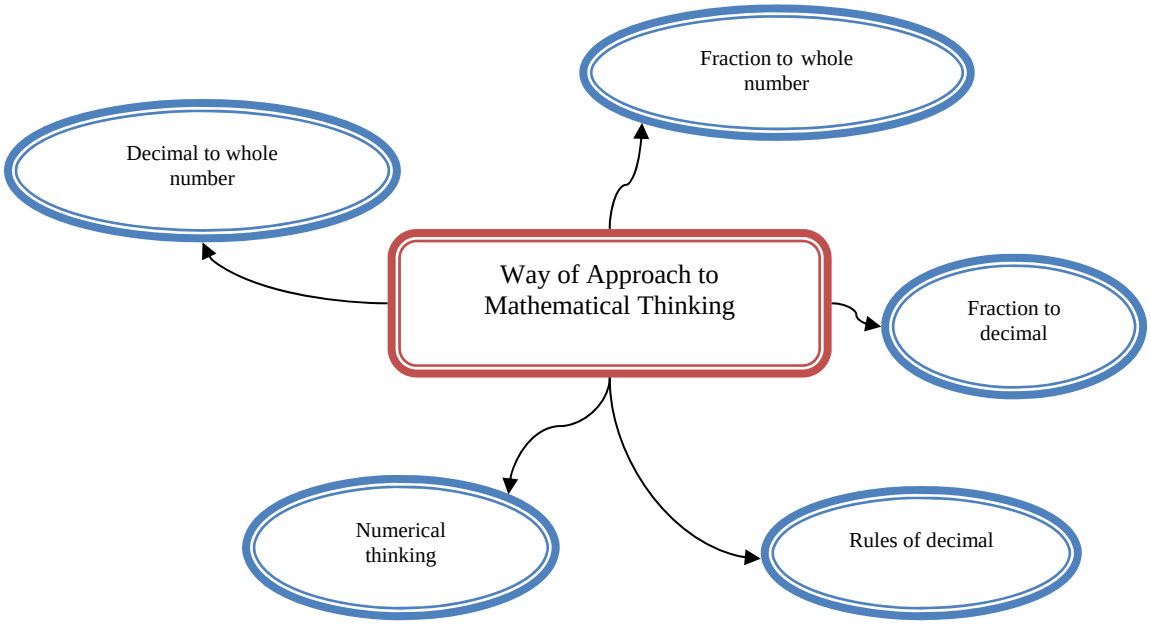

Figure 8. Student's approach to mathematical thinking.

When this Hmong student worked on fractional problem, he had three different strategies to solve the fractional problems. One of the strategies was converting fraction to decimal before he solved the problem. For example, in the problem, "Muaj ib

tug pog laus nws muaj nyiaj $18,000. Thaum nws yuav tuag, nws muab $\frac{1}{4}$ ntawm nws cov nyiaj ntawv rau nws tus txiv. Nws muab $\frac{1}{5}$ ntawm nws cov nyiaj uas seem ntwav rau nws tus ntxhais. Tug pog laus ntawv tseg cov nyiaj uas seem ntawv cia thas nws thaum nws tuag. Yog li xav paub hais tias tus pog laus ntawv nws tus txiv tau nyiaj li cas, tus ntxhais tau nyiaj li cas, thiab ho tshuav li cas rau tus pog laus ntawv?" Translation: In English language, "An old lady has total of $18,000. When she's close to dying, she gave $\frac{1}{4}$ of her total money to her husband. She also gave $\frac{1}{5}$ of the left over money to her daughter. The old lady saves the money that was left over after contributing to her husband and daughter to make her funeral arrangements. In curiosity, how much money did her husband get? How much money did her daughter get, and how much money is left over for the old lady?" This Hmong student changed fraction to decimal, and then he changed the entire fractional equation to decimal equation prior to solving the problem. He worked on the problem step-by-step to get the correct answer. Here is the work that was completed by the participant: "$18,000 (.25) = $4,500; $18,000-$4,500 = $13,500; $13,500(.20) = $2,700; $13,500 - $2,700 $10,800." Although he didn't come up with an equation represented the problem statement, it didn't mean that he understood the problem, but he just chose the easy way to work on the problem because the old lady's husband got $4,500, her daughter got $2,700, and there was $10,800 left for her. Here is the work that was completed by the participant: $\$18{,}000(.25) = \$4{,}500;\ \$18{,}000 - \$4{,}500 = \$13{,}500;\ \$13{,}500(.20) = \$2{,}700;\ \$13{,}500 - \$2{,}700 = \ \$10{,}800$." Although he didn't come up with an equation represented the problem statement, it didn't mean that he understood the problem, but he just chose the easy way to work on the

problem because the old lady's husband got $4,500, her daughter got $2,700, and there was $10,800 left for her.

In addition, when this Hmong student worked on fractional problem, he also converted fraction to whole number prior to solving the problem. For example, in the problem, "The numerator of a certain fraction is two more than the denominator. If $\frac{1}{3}$ is added to the fraction, the result is two. Find the fraction." This Hmong student searched for the lowest common denominator and multiplied both sides of the equation by this number to eliminate the denominator. Here is the work that was completed by this Hmong student: "$\frac{x+2}{x} + \frac{1}{3} = 2, 3x + 6 + x = 6x;\ 4x + 5 = 2;\ 4x + 5 = 6x; 2x = 6; x = 3.$" He changed fraction to whole number after he translated the written statement into algebraic equation, and he solved the problem step-by-step to get the correct answer.

Occasionally, this Hmong student would solve the fractional problem in fractional form when he worked on the fractional problem. For example, in the problem, "If a certain number is added to both the numerator and denominator of the fraction, $\frac{7}{9}$, the result is $\frac{5}{7}$. Find the number." This Hmong student translated the word problem into algebraic equation. He moved the constant to one side and the variable to the other side. He simplified the constant by finding the lowest common denominator, so he multiplied a certain number to the top and the bottom of the fraction to get the same common denominator. He subtracted the numerator and kept the denominator. He didn't change the fraction into decimal or whole number prior to solving the problem. Here is what this Hmong student did: "$x + \frac{7}{9} = \frac{5}{7};\ x = \frac{5}{7} - \frac{7}{9};\ \frac{45}{63} - \frac{49}{63};\ x = -\frac{4}{63}.$"

Another approach to mathematical thinking is the strategies that this Hmong student used to compare a pair of decimal numbers to see which decimal number is bigger, and he was able to apply two different strategies to compare the decimal numbers. One of the strategies that used by this Hmong student was converting decimal number to whole number. For instance, in the problem, “which one is bigger, .125 or .25? Explain.” This Hmong student multiplied both decimal numbers by 100, so he mentioned that $.125$ is bigger than $.25$ because $.125$ is the same as 125. $.25$, on the other hand, is the same as 25. Since 125 is bigger than 25, this means that $.125$ is bigger than $.25$.

The other strategy that used by this Hmong student to compare a pair of decimal numbers to see which one is larger was the decimal rules (decimal place-values). For example, in the problem, “how about 0.0009 and 0.9? Which one is bigger? Explain.” He would line up the decimal numbers and count the digit after the decimal point such as tenth, hundredth, thousandth, and so on to determine which decimal number is bigger than the other. This Hmong student said that 0.9 is bigger than 0.0009 because 0.9 is closer than 0.0009 to the place-value of one. He further explained that if the digit moved to the right after the decimal point, the value is decreased. The digit 9 from 0.0009 is on the ten-thousandth place-value, so it smaller than the digit 9 from 0.9 which is on the tenth place-value.

The next approach to mathematical thinking that used by this Hmong student is numerical thinking. This Hmong student thought about numbers and tried to find the numbers to be his solution when he worked on mathematical problem. He didn’t come up with an algebraic equation prior to solving the problem. For instance, in the problem, “the

sum of two numbers is 13. Their product is 40. Find the numbers." This Hmong student said that the two numbers he needs are 5 and 8 because 5 plus 8 is 13 and 5 times 8 is 40. It is possibly that the problem was easy and making sense to the participant, so the participant was able to work on the problem quickly in his mind to get the answer. It is likely that this Hmong student was remembered the two numbers that fix into the problem, so he just defined the numbers to be his answer because he learned mathematics by memorization as we discussed earlier.

According to the results above, one can say that this Hmong student was able to apply appropriate strategy to solve each type of mathematical problem. He was a brilliant student. He could use a few strategies approached to a particular type of mathematical problem because he understood that there is more than one way to get the same answer. Sometimes he was able to find the answer the mathematical problem in his head. He didn't necessary set up the problem and solve step-by-step to get the answer. He could work on the problem in his head to determine the answer. His brain was functioned so well, which was incredible.

CHAPTER V

SUMMARY AND CONCLUSIONS

This case study examined how a Hmong student learned mathematics in school and how Hmong language affected this Hmong student learning of mathematics. The study found that motivation was an important factor for this Hmong student because it inspired him to continue his education and completed his school work. The five key factors of motivation that influenced the participant's learning of math are parents' support, people's admiration, desire to compete successfully in classroom, interest in assisting others, and desire to be a role model for younger siblings. However, the researcher does not draw a conclusion as to whether or not this motivation can be attributed to the Hmong cultural base or motivation is the result of an individual belief.

The finding of this case study also indicated that this Hmong student learned mathematics in school by following examples, and examples were essential to him because they provided him all the solving steps. Examples acted as a guide for this Hmong student to practice other mathematical problems, so he could remember the mathematical solving steps. Also, he could use examples to study to get ready for in-class tests.

However, given the result from this study, this Hmong student had very limited of learning style. He depended on his memorization, and he just learned to memorize the solving steps from the examples that his instructor provided during the

lecture. This might possibly create a problem for the participant because he might not be able to memorize all necessary solving steps when he worked on other similar mathematical problems that he had done in the past. His memorization would benefit him in the short term, but it would not benefit him in the long run he didn't try to learn and understand the concept of mathematics.

In addition, the result revealed that this Hmong student translated mathematical word problems written in English to Hmong language, and then he would translate from Hmong language to algebraic symbol when he worked on word problems. He translated the written statement to his own language to determine the meaning of the passage before he decided to come up with mathematical equation. The Hmong language is his primary language, and he uses the Hmong language to communicate with his family, friends, and relatives every day. It is reasonable to say that the Hmong language might help this Hmong student understanding of mathematical context better than English language. However, difficulties arose when the participant translated mathematical word problem from English into Hmong. He translated the word problem straight from left to right regardless the structure of the statement because the Hmong language is read and written from left to right, and the meaning of each word of the passage in Hmong language is also strictly from left to right. Another disadvantage from Hmong language is that there are limited Hmong words and that especially mathematical vocabulary is undeveloped in the Hmong language.

Given these issues, the participant would mistranslate some mathematical vocabulary in Hmong, and the Hmong language would change the meaning of the problem statement when he translated the word problems into Hmong. Since English is

this Hmong student second language, this created another complexity of the task for the participant. Therefore, this indicated that language is an issue for this Hmong student.

Moreover, the result from this case study pointed out that diagrams did not help this Hmong student learning mathematics. It is likely that this Hmong student might not have had the opportunity to explore and use diagrams to explain important mathematical concepts in the past. More research is needed to investigate how Hmong students use diagrams to solve mathematical problems in the future.

Given the language issues described above, this Hmong student may have benefitted from additional experiences developing academic language especially mathematical vocabulary. Teachers of this Hmong student may need to provide more examples of mathematical word problem by slowly showing step-by-step solutions during class time. Teachers of this Hmong student may need to serve as a guide, creating active classroom discussions, and encourage this Hmong student to join the discussions. Moreover, teachers of this Hmong student may need to allow more time for this Hmong student to think about the problems, especially when trying to understand and become comfortable with some mathematical vocabulary.

Recommendations

This case study was needed because the Hmong people have not been in the United States very long, and there has not been many studies done with respect to Hmong students' educational experience, especially in mathematics. This study provided a good example of how Hmong students learn mathematics in school, what influences them to go to school every day, and how the Hmong language plays a role in Hmong students'

learning experience. Since this is a case study, the researcher used the data to paint a picture of this Hmong student's educational experience, especially in mathematics.

Finally, the researcher wants to pose some research questions that arose from the case study. 1) Do Hmong students rely on memorization and practice more than other English language learners and English speaking students? 2) Does the left to right structure of Hmong language create an issue of difficulty for the Hmong students to translate from word problems to algebraic expressions? 3) How does the lacked of fractional terminology and other mathematical terms in the Hmong language influence the way the Hmong students think about fraction? 4) Is the educational experience of Hmong students who born in the United States the same as the educational experience of the Hmong students who moved to the United States?

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APPENDIX A

Informed Consent Form

Informed Consent Form

Purpose of the research: The purpose of this research study is to seek an understanding about Hmong students learning of mathematics in school conducted by Moua Xiong at CSU, Chico.

Procedures: The participant will be interviewed with at least 50 questions. The questions will be about the participant's school experience when learning mathematics as well as about the participant background. The interview will be carried out in several sessions over. The participant will meet with researcher twice a week, and each session will be about an hour long. The researcher will take note and use audiotapes to record the conversation so the information can be reviewed later.

Risk/Discomforts: There are no anticipated risks associated with participating in this study because the participant just talks about his or her school experience and his or her information will be protected.

Benefits: There are no direct benefits for the participant. However, the researcher hopes that your participation will help researcher learns more about Hmong students learning mathematics in school.

Confidentiality: All information from the participant will remain confidential and will only be used to complete the research study. All data will be kept in a secure location, and all data will be destroyed after the research is completed. The researcher will assign a fake name to the participant instead of using the participant real name to complete the research in order to protect the participant from any embarrassment and discrimination.

Compensation: There is no compensation for the participant, but participant will receive a hard copy of thesis from the researcher after the research study is completed.

Participation and withdrawal: Your participation in this study is completely voluntary, and you may withdraw at any time without any penalty. You may withdraw by informing the researcher that you no longer wish to participate and no questions will be asked.

Person to contact: If you have any question, you can contact me, Moua Xiong at (530) 403-0261, or email me at: mxiong6@mail.csuchico.edu. You can also contact my graduate advisor, Dr. Berglund at (530) 898-5350, or email him at: jjberglund@csuchico.edu.

Whom to contact about your right in this research: For questions, concerns, suggestions, complaints that are not being addressed by the researcher, or in case of research-related harm, you can contact Office of Graduate Studies in Chico State or Marsha Osborne at (530) 898-5413. Email: mlosborne@csuchico.edu.

Agreement:

The nature and purpose of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without penalty.

Signature: _____ Date: 10/25/11

Name (print): Tova mengka Yang

APPENDIX B

Student and Parent's Questionnaire

Student Interview Questionnaire

Life in the Thailand Camp

1) Where were you born, and when were you born?
2) Did you go to school in the camp? Explain in detail. Some follow-up questions.
3) Tell me a little about how your life in the camp before you came to the United States? Explain in detail. Some follow-up questions.

Life in the United States and Elementary School

4) When did you come to the United States?
5) Where did you first start your school?
6) Where do you live now in the United States?
7) What grade did you start here in the United States?
8) How did you feel about the first day you were in class in this country? Explain.
9) What school mean to you at that time, the first time you went to school? Explain.
10) What was the first thing come to you mind when you went to school? Explain.
11) Did you parents (father or mother) tell you to go to school, or did you want to go to school by yourself? Explain.
12) What language did you usually use to communicate with your parents, siblings, and relatives? Explain. Some follow-up questions.

13) How did you feel about learning English in the United States? Was it difficult or not? Explain
14) How long did it take you to speak the first English word in class with your teacher, classmates, or others? Explain. Some follow-up questions
15) What did you like to do the most in school when you first started school over here in the United States? Some follow-up questions
16) As you remembered, when did you start to learn math or do math? What did you do at that time? For example, did you count the number, add, subtract, or etc? If you counted the numbers, what objects did you count to represent number? When did you start to perform the mathematical operations (in what grade level)? Any mathematical operations that you struggled when you started to do it?
17) What math level did you complete in elementary school? Explain in detail
18) Tell me about your math experiences in elementary school. Explain in detail.
19) What did math mean to you in elementary level? Explain in detail

Experience in Middle School

20) What math classes did you take and complete in your junior high years?
21) Tell me about your math experience in middle school. Some follow-up questions.
22) What was it like to have English be the language used in the math class in junior level? Explain.
23) What was it like to have English be the language used in other classes in junior level? Explain.

Experience in High School

24) What math class did you take in your first year of high school? Some follow-up questions.
25) What was the highest math class you took in high school? Some follow up questions.
26) Did you graduate from high school? In what year? Some follow-up questions.
27) How did you feel about your high school math performance/skill? Explain.

Experience in College

28) When did you enroll or transfer from high school to college?
29) What math level did you get when you took the college assessment test? Some follow-up questions.
30) What year are you now as a college student?
31) How are you doing in your present math class in college? Explain in detail.
32) Where did you usually sit in math class? Explain. Some follow-up questions.
33) If you don’t get the concepts from the lecture, what do you do? Explain.
34) Just focus on the mathematical subject, what math topics do you like the most and you don’t like the most right now? Explain.
35) What teaching strategies do you like and feel that can help you to understand about mathematics?
36) What does math mean to you right now, and why do you take math? Explain in detail.

37) Assume you are sitting in a math class or anywhere, and you hear the term "mathematical word problems," what will be the first thing coming to your mind? What do word problems mean to you now? Explain. Some follow-up questions.

38) What do you think about your experiences of solving mathematical word problems from the past to now? Explain.

39) What is the big issue that you think mathematical application problems difficult for you? Explain.

40) What do you think will help you to overcome your difficulty with the mathematical application problems whether a lot or just a little? Explain. Some follow-up questions.

Student Perform Mathematical Word Problems

Questions will be varied depending on how the student performs the problems. The questions will follow directly after the student come up with the equation. The questions will seek an insight and an understanding of how the student works on the application problems from both language versions, English and Hmong.

Parents Interview Questionnaire

1) What grade level did you complete? Explain.
2) What do you do now? Some follow-up questions
3) Did you encourage your children to go to school in here, and how did you support your children school activities such as homework, tests, and etc?
4) What do you expect your children, especially the student that I choose to do the case study, to achieve in school or to be in the future? Some follow-up questions
5) Anything that I didn’t ask, but you want to tell me about it.

APPENDIX C

DATE ANALYSIS Draft

#	Categories	Code	Subcategories
1	Hmong language	**HL**	
2	Translate from left to right	**LR**	Relate or belong to C1
3	Use English to translate	**ET**	
4	Language Structure	**LS**	
5	Algebraic variable	**AV**	Mathematical language
6	Operation with Whole Number	**WN**	Relate or belong to C1
7	Operation with Decimal	**D**	Relate or belong to C1
8	Operation with Fraction	**F**	Relate or belong to C3
9	Vocabulary	**V**	Relate or belong to both C1 &3
10	By Learning Experience	**LE**	Relate or belong to C11
11	Memorization	**M**	Relate or belong to C10
12	Practicing	**P**	

The following interview sessions will be analyzed and assigned the above letter codes to form into categories.

First Interview: This interview session will be divided by the sentences, and each sentence is labeled by a number.

Sentence	Text Message	Code
1.9	Most of the time we just used Hmong.	HL
1.12	I didn't know that it was making sense. I just spoke straight as Hmong language.	HL

Second Interview:

Sentence	Text Message	Code
2.16	In fact, I got those addition problems by memorization and by the strategy that teacher taught about put things together such as one group of 5 apples and another group of 7 apples.	M
2.17	It just helped me because I learned by memorization, so it just helped me.	M
2.17	In fact, I just practiced a lot and memorized those ideas from my parents and teacher, so I could get it.	P, M

12.1	This is I just translate as I understand	M
12.1	Hmong language does not have specific form to mean exactly as fraction.	HL
12.2	This statement if say in Hmong language I do not understand and do not know.	HL
12.2	Because Hmong language speak in different, 1 2 bigger than 1 3 by 3 2 times.	HL
12.2	To translate in Hmong language, it confuses me to make me do not know.	HL
12.2	If speaking in English, I believe that it is liked the statement if I solve algebraically.	ET, AV
12.2	If I see something like this, I use English language to do, not really the Hmong language.	ET, HL
12.2	If to explain in Hmong language for the Hmong students to understand, it is difficult.	HL
12.2	To me, I just say 3 over 2 times 1 over 3 gets 1 half.	V
12.2	Hmong language doesn't have specific to indicate, so it is difficult because two three things just use only one Hmong word to say.	HL

Thirteenth Interview:

Section	Text Message	Code
13.1	To me, I say 2 3 of the pizza, or this pizza has 2 3 pieces.	WN
13.1	For example, my dad bought a pizza, I said give me 2 3 of the pizza to me, so I think my dad would give 2 or 3 pieces of pizza to me.	WN
13.1	They don't know that to cut the pizza into equally pieces and then give 2 over 3 of the pizza to me because in Hmong language, most of the time, just uses only one number, so doesn't have fraction at all.	HL, WN, F
13.2	if I say give 5 over 3 although they cannot give exactly 5 over 3 to me,	V
13.2	If involve the word over, it means fraction to those Hmong that are going to school and it also stands for fraction.	V, F
13.2	That means I already use English and Hmong together.	ET, HL
13.2	I understood because it was those words that I usually saw in the past.	M
13.2	When I performed mathematical problems whether it was fraction or not, I always thought and used Hmong language to involve because Hmong language was the language that I used since I knew how to speak.	HL
13.2	I always thought in Hmong and then would translate into other languages such as English. I	HL
13.2	In addition, if speak in Hmong language, it helps me to understand, and it is not too difficult.	HL
13.2	Only those terms that not exist in Hmong word, I will use directly of that language (English).	V
13.2	Anything besides that must translate in Hmong and than from Hmong to that specific language to me.	HL
13.2	The Hmong language played a big role because when I was doing math or other	HL

	things totally speak my own language get more understanding than speaking in English.	
13.2	The most difficult part of Hmong language is that the Hmong language doesn't have lots of words (vocabularies) to match every of English word (vocabulary).	V
13.2	When we were group and the teacher assigned the problems about fraction, we used both Hmong and English if everyone understood about English.	HL, ET
13.2	If use English or the word "over", it was easy for everyone to understand about fraction, and it wasn't confuse as saying in Hmong language.	ET, V, HL
13.2	Most of the time, I used both Hmong and English together about fraction.	HL, ET
13.2	In addition, if translate the word "over" in Hmong language, it doesn't make sense and it doesn't translate as fraction, too.	V, HL, F
13.2	It means pass or too much, so it is nothing related as using in English for fraction and use for fraction in English.	V, ET, F
13.2	It is not easy to speak the fractional word in Hmong language for every Hmong to understand to me.	V, HL
13.2	The language that doesn't have any Hmong word, I used memorization and practice to learn those terms that not existed in Hmong language.	M, P
13.2	Since you didn't know, you needed to practice because even though you spoke in Hmong, there didn't have anything to indicate, so you just practiced until you memorized.	P, P, M
13.2	If you didn't practice, you couldn't memorize, so this was the biggest strategy I used to learn.	P, M
13.2	I memorized in English there wasn't any Hmong word to translate and say as that.	M, V
13.2	For example, fraction must mean one number over another number. I memorized just like that.	V, M
13.2	If some easy mathematical problems like 1 + 2, I would use the Hmong language to say 1 plus 2 because the Hmong has the word "add" in Hmong language.	HL, V

Fourteenth Interview:

Section	Text messages	Code
14.1	What I understood so forth, the older son gets one-fifth of the land, and the second son gets one-fourth of the land.	LS
14.1	What I know from the problem is 1 over 4 and 1 over of the land that will give to the 2 sons.	LS
14.1	I took 1/4 + 1/5 = 9/20, so it was the land that the father gave to the two sons.	F
14.1	So I said that the land is 20/20 because 20/20 it is 1, so I solved and got 11/20 was the land that left.	F, WN

14.1	If worked on it, the second son will get more because if I divided into decimal form or percent that is not in fractional form, the second son will get more than.	D
14.1	If I want to say in Hmong for the Hmong children to understand that 1 4 is bigger than 1 5 is hard.	HL, WN
14.1	So, even though I go to explain that the older son gets 1 5 and the second son gets 1 4 of their father's land, so they will say that the older son is getting 1 5 it's bigger than 1 4.	WN
14.1	If speak in Hmong language, it is very difficult because we don't have the fraction word like this.	HL
14.1	If they still don't understand, then just do like 1/4 = .25 and 1/5 = .20, so .25 is 25 cents and .20 is 20 cents.	D, WN
14.1	Or just subtract (.25 - .20 = .05), .25 is bigger than .20 because it left with .05.	D
14.1	It is not making sense in Hmong language because Hmong people didn't use fraction in the past (in Laos).	HL, F
14.1	They usually just used the whole numbers, so it confused them and I regarding fraction.	WN
14.1	I usually turned fraction into decimal before solved it.	D
14.1	To me, after I read this problem, I thought and translated into Hmong language, so I started to find to see what it was about.	LS, HL
14.1	When I found I also thought in Hmong language in my mind.	HL
14.1	If I thought in English, it was confused me because there are too many English words.	ET
14.1	I said 1 over 4 and 1 over 5.	WN
14.2	At first I wrote as the equation 1/4x + 1/5y = 15, so I think it wasn't correct.	AV
14.2	Therefore, I changed again by writing $\frac{1}{5} times\ 15\ and\ \frac{1}{4} times\ 15$	F
14.2	When I took the results to add together, I got 6.75, so I took 15 again to subtract 6.75 I got 8.25.	D
14.2	I always used decimal to find the answer when I performed fraction.	D, F
14.2	There were a few times that I used fraction because fraction was difficult and sometimes I did it, so it was wrong didn't get the answer.	F
14.3	Here I translated four pounds and one-third of nails so write $4\frac{1}{3}$ because it said exactly that four and one-third pounds of nails, so I just got that.	LS
14.3	The small box was three quarters of the pound. Quarter so 1 quarter is 25, so 3 quarters is 75 or 75 percent.	WN
14.3	So I know that 75 percent is 3/4 by memorization from my learning experience.	LE
14.3	When I did the math, I multiplied out (13/3), so I divided by 3/4 to get how many boxes.	F
14.3	If you divided, you must flip for being able to multiply to get 52 over 9.	WN
14.3	I brought to solve as division problem so I got 5.77. 5.77 was the total of the boxes that will use to put the nails in.	D

14.3	I used most of Hmong language combined with English.	HL, ET
14.3	Three quarters I translated and said that quarter it was 3 times, so it had 75 to me.	LS
14.3	They want to put those nails into the small boxes. Each small box has 3 quarters 1 pound or .75 or 3 over 4 (three-fourth),	D, WN
14.3	Translate .75 or 3 over 4.	D, WN
14.3	If they do not understand about 4 and one-third pound, so you can say 4 pounds and 1 3 pound add.	WN
14.3	In addition, because the land says that give 1/4 and 1/5 to the two sons so just subtract the part that give to the two sons.	LS
14.3	As for the nail problem, it says that must put in the small box and will need how many small boxes, so it is divided.	LS
14.3	When it writes in different, it requires different operations to do. I'm confused about English language; moreover, cannot translate in Hmong language.	HL
14.3	The most difficult part to me about the word problems are I cannot translate English into Hmong language.	HL
14.3	I like to use decimal because decimal is liked whole number to me, so I understand more and it is not often mistake when I attempt.	D, WN
14.3	When I got the answer as decimal, I could not change to fraction because it wasn't easy and I didn't understand.	D, F

Fifteenth Interview:

Section	Text Message	Code
15.1	Talk about .25 and .125, .125 is bigger because I times by 100, so I got 25 and 125 so 125 is bigger than.	WN
15.1	just subtract . 125 − .25 = 100.	D
15.1	It left with 100, so .125 is bigger by 100.	WN
15.2	To talk about this one, .9 it's bigger than because according to my learning experience if it move little far to here (to the right of the decimal point), so the value goes down.	LE
15.2	Because I forgot to take the decimal to line up.	D
15.2	When I learned, the teacher was teaching to line up the decimal for the value to be the same.	LE, D
15.2	By my learning experience, I didn't use diagrams, and all of my teachers didn't use diagram to show us.	LE
15.3	1 3 is bigger than 1 4 because if turns as decimal, 1 3 is .333..., but 1 4 is .25.	WN, D
15.3	If speak in English, I think 1 3 is bigger than 1 4 by 3 4.	ET, WN
15.3	For example, 1/3x3/4 = 3/12 = ¼ by reducing.	AV

15.3	At first, I thought it is $\frac{1}{3.5}$ because it is the number between 3 and 4, but maybe it is not.	D, F
15.3	The bottom number may not be decimal.	D
15.4	The two trees have the same high because both tree high 3 feet the same in the next 2 months.	LS

Sixteenth Interview:

Section	Text Message	Code
16.1	I understand that this old lady has $18,000, and she gives to her husband and daughter.	LS
16.1	The reason I know is because it says exactly in Hmong language as that.	HL
16.1	Because it says in Hmong language exactly like that, so I can understand much better.	HL
16.2	I took x to be the number that I don't know and they talked about that.	AV
16.2	So, three time the fraction $\frac{2}{3}$ is $3 \cdot \frac{2}{3}$.	F
16.2	If put all together, it is $x + 3 \cdot \frac{2}{3} = 9$.	AV
16.2	To me, if write in Hmong language I understand better than write in English because Hmong language is straight forward and just has only one word,	HL, HL
16.3	What I did I take x to be the number that they mentioned and I don't know, so the two consecutive integer is x and x + 1.	AV, AV
16.3	So, I write all together is x(x + 1) = 5(x + x + 1) – 13. I solved step by step so I got x = 8.	AV
16.3	To me, when I read the passage that write in Hmong language I understand much better.	HL
16.3	If I understand I can write as an equation, and when written in Hmong language, it doesn't confuse myself.	HL
16.3	It is not the same as English although I understand, but I cannot write as an equation that correct as the teacher expect and as the passage it says.	LS
16.4	To me and what I understood from this mathematical problem is that "sum" means add and "times" means multiply and "it" it's talking about 10.	V, V
16.4	Therefore, it is $x + 10 \cdot \frac{1}{10} = 7$.	AV

Seventeenth Interview:

Section	Text Messages	Code
17.1.1	I got this is because the passage tells me that 23 subtract a number, so I just wrote as that.	LS
17.1.1	Because it says precisely in Hmong language that 23 subtract a number.	HL
17.1.1	that's why I use x to represent that number because we learned it just liked that.	AV

17.1.2	I just translated the same as the above problem because it says that a number adds to 17, so I just let x be the number adds to 17.	LS, AV
17.1.2	The words are not the same, but they are the same writing format to me because it says in the Hmong language precisely as that and it write and translate from left to right in Hmong language like that.	HL, LR, HL
17.1.3	five times a number is 5 times x because "zaus" is times, but it says in Hmong.	AV, V, HL
17.2.1	I just translated from left to right that 32 divided by a number;	LR, LS
17.2.1	that is $32 \div x$ because this passage says in Hmong as that.	LS
17.2.1	I just wrote exactly as it says.	LS
17.2.1	Yes, I just do that if it already writes in Hmong language like that.	HL
17.2.2	When I read this passage, it tells me that subtract a number from 52.	LS
17.2.2	The reason I did that because it tells me that I must let 52 subtract a number.	LS
17.2.2	It is an opposite language.	LS
17.2.2	But, it is Hmong language, so it specific precisely and I understand as that.	HL
17.2.2	To me, I believed that it is liked that because it says in Hmong language likes that as same as I usually spoke in my language in the past.	HL
17.2.3	I just translated as Hmong language from left to right.	HL, LR
17.2.3	"More than" means add because I learned from my math class, so I used English to translate as I remember.	V, ET
17.2.3	So it is x + 2. "add" is add because it also means as that in Hmong language.	AV, V, HL
17.2.3	This problem is same as the Hmong language because it goes straight forward from left to right, so it is not too difficult.	HL, LR
17.2.3	The reason I got fraction because the problem is talking about fraction.	LS, F
17.2.3	The reason I thought it is the same as Hmong language because it communicated straight forward from left to right as same as Hmong language, so it is not difficult.	HL, LR, HL
17.2.3	That's the reason I used whole number and decimal to solve when I saw fraction.	WN, D
17.3.1	I got this because it says that add a number to the numerator and denominator.	LS
17.3.1	To me, to add a number to the numerator and denominator of the fraction, it is the same as adding a number to the fraction.	LS C1
17.3.1	That's why I got x + 7/9 = 5/7.	AV
17.3.1	This problem says that add a number to the numerator and denominator, so that I just got like that.	LS
17.3.2	From the learning experience, "even integer" is the numbers that not one from each other.	LE, V

17.3.2	Therefore, I let x to represented the first number that I didn't know, so the second number was x + 2.	AV
17.3.2	When I wrote all together, I got x(x + 2) = 5x – 10 or x(x + 2) 10 – 5x.	AV
17.3.3	At first, I thought it was divided, so I took 25500 divided by 2 over 5, so I flipped and multiplied I got 63750.	LS
17.3.3	I changed my problem into multiplied such as 25500 times 2 over 5.	LS

Eighteenth Interview:

Section	Text Message	Code
18.1	I read this problem, I could understand too but not all of it, so I could not write all together.	LS
18.1	What I understand is that "more than" means add and "product" means multiply, but I cannot put all together to form exactly an equation.	V
18.1	I used English to translate the word "more than" and "product" because I learned usually translated as add and multiply in English.	ET, LE
18.1	I didn't use Hmong language because in Hmong language the word "more than" means too much or a lot, so it is not added to me.	HL, V
18.1	I also didn't use Hmong language to translate the word "product" because it didn't mean multiply in Hmong language to me, too.	HL, V
18.2	what I understand is that two numbers if add together is 13 and times together is 40,	LS

#	Categories	Initial Letter Code	Code
1	Translate from left to right	tlr	TLR
2	Memorization	m	M
3	Procedural Thinking	pt	PT
4	Conceptual Understanding	cu	CU
5	Translate the problem correctly	tpc	TPC
6	Translate the problem incorrectly	tpic	TPIC

Student current mathematical performances during the interview that have been interpreted by the researcher are as follow.

Fourth Interview:

Section #	Interpretation by Researcher	Initial	Final
4.1.1	Question 1: Two more than a number. Student work: 2x, 2 + x;	tlr, tpic, tpc, m	TLR
4.1.2	Question 2: Two less than a number. Student works: $2< x,\ 2 - x.$	tlr, tpic	TLR

4.1.3	Question 3: The total of fifty and a number. Student works: 50 + x.	tlr, tpc, pt, m	TLR, M
4.2.1	Question 4: Twenty divides a number. Student works: 20 ÷×.	tlr, tpic	TLR
4.2.2	Question 5: Thirteen divided by a number. Student works: 13 ÷×.	tlr, tpc	TLR
4.2.3	Question 6: Five goes into a number. Student works: $5 \cdot x$.	tlr, tpic	TLR
4.3.1	Question 7: Seventeen minus a number. Student works: 17 – x.	tlr, m, pt	TLR, M
4.3.2	Question 8: Subtract fifteen from a number. Student works: x – 15.	m, cu, tpc	CU, M
4.3.3	Question 9: 3 feet equal 1 yard. Let f = feet and y = yard, so write an equation represents the word. Student works: y = 3f or 3f = y.	tlr, tpic	TLR

Researcher interpretation and comment of the session: The students translated almost all the problems from left to right as same as Hmong language. The student failed to apply mathematical concept to translate the problems, but he just translated the passages straight forward exactly as what he read from the passages. This has been shown that he relied a lot on Hmong language. If the passage, for example, goes straight forward from left to right as same as Hmong language, he can translate the problem correctly. However, if the problem is written in English standard form, the student cannot translate it into mathematical symbol or expression because it doesn't go from left to right. In addition, the student didn't consider about whether the translation was correct or not. At the same time he didn't confident about his translation. For example, the student had two answers or expressions for a particular word problem. This revealed that the student didn't understand and didn't confident about it.

According to the student works and explanation, the student just used Hmong language to translate the problems most of the times. Although he used English to translate the words such as more than and less than, he also used Hmong language to translate the other parts, numerals, those words that exist in Hmong language and combined all together. Therefore, this shows that the Hmong language is affecting his thinking and learning of mathematics in English, and it also shows that language is an issue for him about learning mathematics in school. For example, the word "goes into," he interpreted as multiplication. He misunderstood about the language itself. He

translated the word into Hmong, and then he would translate from Hmong language into mathematical language one more time.

Eleventh Interview:

Section	Interpretation by Researcher	Initial	Final
11.1	Question 1: What would you think if a teacher told you about the fraction a/b and the division problem a divided by b are related but different mathematical ideas? Do you believe that statement, or if you can explain in Hmong language how they are different? Student respond: The fraction a over b and the division a divided by b are different to me. The fraction a over b is a b or 1 2 to me in Hmong language. For the division, it indicates that you must divided a by b.	pt	PT
11.2	Question 2: Now, consider the fraction $\frac{3}{4}$ and the division $3 \div 4$ by illustrating the pictures, how does it look like to you? Student respond: The fraction $\frac{3}{4}$ and the division $3 \div 4$ are not the same if speak in Hmong language or draw a picture. The fraction $\frac{3}{4}$ is the same as the division $4 \div 3$ because the picture of each statement has one item the same left.	pt, tpic	PT
11.3	Question 3: Look at the fraction 1/2 and 1/3, which fraction is bigger? If so, how much larger by the fraction? Student respond: To understand which fractions, 1/2 or 1/3, is bigger, you must divided to get decimal numbers. To do that, 1/2 is .5 and 1/3 is .3333, so 1/2 is bigger than 1/3 by .17.	pt, tpc	PT

Researcher interpretation and comment of the session: The student did not quite understand about the difference and similarity between fraction and division. He was misconception about it. He didn't use conceptual understanding with reasoning to state the problems, but he only used procedural thinking to answer the problems. That's why he said that fraction is the opposite of division in Hmong language and pictures to him, so it seemed that the student was still relied on the Hmong language. Even though the student relied on the Hmong language and Hmong language didn't have a fractional word, the student ought to understand that the two concepts supposed to end up with the same answer. For example, if there is same answer in English, it must be the same answer in Hmong language, too. Although the languages are different, the answer supposes to be the same.

Twelfth Interview:

Section	Interpretation by Researcher	Initial	Final
12.1	Question 1: 1/2 is bigger than 1/3 by 1/6. Do you believe and think so? Why? Explain, and how can you explain or say the fraction in Hmong language? Student respond: I believe that 1/2 is bigger than 1/3 by 1/6 if I do in algebraically. In addition, if translate in Hmong language, I just say 1 2 bigger than 1 3 by 1 6. There is no anything to indicate fraction in Hmong language because there is no a fractional word exists in Hmong language.	pt, m	PT
12.2	Question 2: Do you believe that 1/2 is bigger than 1/3 by 3/2 times? How do you say and explain in Hmong? Student respond: If speak in Hmong language, I don't believe that the statement will turn out as that. However, if speak in English and solve algebraically, I believe that the statement is true. To solve in algebraically, I take 1 over 3 times 3 over 2 to get 3 over 6 so reduce to get 1 over 2, so I believe.	pt, m	PT

Researcher interpretation and comment of the session: The student failed to use the proportional reasoning to get the full answer. He said that he could use algebraically to solve the problem, but it seemed that he misunderstood about how to use algebraic reasoning to handle the problem. He accidentally got the expression 1/3 times 3/2 equals 1/2, but he didn't understand about it. What he mentioned about algebraically and what he did obviously didn't match. This revealed that he misunderstood about the problem. In addition, according to his statement for the second problem, he said that he didn't sure and disbelieve that the statement is true in Hmong language. He continued to say that he believed in English if he used algebraically to solve the problem. If the statement wasn't true in Hmong language, it was impossible to be true in mathematical language and English, too. This indicated that the student didn't sure about his respond, and he just relied on the first problem. The student didn't understand about algebraic concept and other mathematical concepts. He failed to use what he learned from school.

Thirteenth Interview:

Section	Interpretation by Researcher	Initial	Final
13.1	Question 1: How do you say 2/3 of a pizza in Hmong? Student respond: To me, I say 2 3 of the pizza, or this pizza has 2 3 pieces. If my dad bought a pizza, I said give me 2 3 of the pizza to me, so I think my dad would give 2 or 3 pieces of pizzas to me. They don't know that to cut the pizza into equally pieces and then give 2 over 3 of the pizza to me because in Hmong language most of the time just uses only one number.	pt	PT
13.2	Question 2: How do you say 5/3 of the pizza in Hmong? Student respond: I just say 5 3 of the pizza. But to speak for people to understand, I think I just say give 5 pieces to me. If speaking in Hmong, it is hard, don't know, and confuse. However, if I say give 5 over 3, I think the young Hmong students who are going to school can understand even though they cannot give me exactly 5 over 3 of the pizzas to me.	pt	PT

Researcher interpretation and comment of the session: It was obviously that there was no a fractional word in Hmong language, so it was difficult for the student to translate the fractional term in Hmong language to the Hmong people. In order for the Hmong people, especially the young Hmong students to understand about the fractional term in Hmong language, the student needed to borrow the word "over" or speak exactly the word "fraction" for the young Hmong students, so they could understand what it was. Therefore, student felt uncomfortable if translated or said fraction in Hmong language for the Hmong people. The Hmong people might not understand the term if it was not involved the word "over".

Fourteenth Interview:

Section	Interpretation by Researcher	Initial	Final
14.1	Question 1: A farmer wants to give a part of his land to his two sons. His eldest son will get 1/5 of the land, and his youngest son will get 1/4. Who will get the larger portion of the land? How much of the farm remains for the farmer? Student works: $\frac{1}{4}+\frac{1}{5}=$ $\frac{9}{20}, so \frac{9}{20} is\ the\ land\ giving$ to the two sons. $\frac{20}{20}=1\ the\ land. Then, \frac{20}{20}-\frac{9}{20}=$ $\frac{11}{20} the\ remaining\ land.$	pt, tpc, m	PT
14.2	Question 2: Let's say if the land is 15 acres. What will you do? Student works: $\frac{1}{5}x+\frac{1}{4}y=15;\ \left(\frac{1}{5}x+\frac{1}{4}y=15\right)20;\ 4x+5y=210;$ $5y=210-4x;\ \frac{1}{5}\cdot 15=3;\ \frac{1}{4}\cdot 15=\frac{15}{4};\ 4\sqrt{15}=3.75;$ $3.75+3=6.75;$ $15-6.75=8.25$ acres of land remains.	tp, tpic, m	PT
14.3	Question 3: You are working at a hardware store. There are four and one-third pounds of nails that need to be placed into small boxes. Each small box needs three-quarters of a pound of nails. How many boxes do you need? Are any nails left? Student works: $3\left(\frac{1}{4}\right)=\frac{3}{4}=.75;\ 4\frac{1}{3} pounds;\ 4\frac{1}{3}=\frac{13}{3}$ $\frac{13}{3}\div\frac{3}{4};\ \frac{13}{3}\cdot\frac{4}{3}=\frac{52}{9}=5.77;\ .77-.75=.02;\ 5+1=6;$ There are 6 small boxes and 2 nails left over.	pt, tpic	PT

Researcher interpretation and comment of the session: The student interpreted first two problems with the same operation, but he interpreted the third problem with different operation. He believed that if the problem written in different form or language, the operation was also different. This means the student doesn't confident about word problem. The fact is that he did not quite understand every word he read from the problem. He struggled with the language itself, not the mathematical symbol. If he read the problem and understood it, he must able to translate the problem into mathematical symbol and solved to get the answer. According to his mathematical performance, he

liked to work with whole number because he turned fractional problem into decimal number before he solved it. This also showed that he was still struggled with fraction, and he didn't feel comfortable and confident about fraction at all.

In addition, he didn't very sure about all the mathematical symbols that he translated from the word problem. He just took a guess and came up with the answer. When he got the answer, he was disbelieved about it because there were some terms that he just added to the mathematical equation such as 20/20 and the equation $\frac{1}{5}x + \frac{1}{4}y = 15$. To me, it seemed that he just tried to translate the word problem into equation and solve the equation to see that the answer seemed right to him or not. If, for example, the answer seemed suitable to him, he could take it. However, if the answer seemed unsuitable to him, he would change the direction by using another method to solve the equation or translate the word problem into equation again. This means that he didn't use conceptual learning to handle each problem, but he might only use procedural thinking and memorization to handle each problem. That's why he got different operation for different word problem when the problem was written in different form.

Fifteenth Interview:

Section	Interpretation by Researcher	Initial	Final
15.1	Question 1: Which one is bigger .125 or .25? Explain Student works: .125 (100) = 125; .25(100) = 25 or .125 - .25 = 100 and .25 - .125 = -100.	pt, tpic, tlr	PT
15.2	Question 2: How about .0009 and .9? Which one is bigger? Explain. Student Respond: To talk about this problem, .9 it's bigger than because according to my learning experience if it move little far to here (to the right of the decimal point), so the value goes down. Therefore, if this problem is liked this, the top problem the value also goes down, too.	cu, m, tpc	CU, M

15.3	Question 3: For the fraction $\frac{1}{3} and \frac{1}{4}, which\ fraction\ is\ greater. Find$ a fraction between the two fractions. Student respond: 1 3 is bigger than 1 4 because if turns as decimal. 1 3 is .3333…, but 1 4 is .25. Therefore, 1 3 is bigger by .08. If speak in English, I think 1 3 is bigger than 1 4 by 3 4. For example, 1/3x3/4 = 3/12 = 1/4 by reducing. Also, I thought at first that 1/3.5 is the fraction in between the two fractions because 3.5 is between 3 and 4, but it is not. The bottom number may not be decimal. Finally, I don't have the number in between the fraction 1/3 and 1/4.	pt, m, tpc, tpic	PT, M
15.4	Question 4: There are two trees. Tree A is 5 feet tall, and tree B is 8 feet tall. Two months later, tree A is 8 feet tall, and tree B is 11 feet tall. Do the two trees grow the same or different? If so, which tree grows the more and why? Student respond: The two trees have the same high because both tree high 3 feet the same in the next 2 months. It doesn't matter how the trees start, but they just grow up the same 3 feet the same in the next 2 months, so they grow up the same.	pt, tpic	PT

Researcher interpretation and comment of the session: The student thought about whole number and decimal number rather than fraction. The student turned fraction into decimal number and decimal into whole number before he could get the final solution. Examples and practices were very helpful to the student. For example, when he attempted the first question, he forgot to line up the decimal number, so he got the wrong result. When he tried the second question, the problem provided him a big hence that he needed to line up the decimal number before he could do anything. Practices and examples refreshed the student memorization that the more decimal number toward the right of the decimal point is the lower value of the digit. It seemed that he could notice about what he made mistakes if he worked with decimal number more than if he worked with fraction. However, when compared decimal number and fraction, the student understood decimal number more than fraction because he could describe the steps of handling decimal number better than fraction. This shows that the student could use mathematical concept when he faced with decimal problems.

Sixteenth Interview:

Section	Interpretation by Researcher	Initial	Final
16.1	Question 1: Muaj ib tug pog laus nws muaj nyiaj $18,000. Thaum nws yuav tuag, nws muab 1/4 ntawm nws cov nyiaj rau nws to txiv. Nws muab 1/5 ntawm nws cov nyiaj uas seem ntawv rau nws tus ntxhais. Tus pog laus ntawv tseg cov nyiaj uas seem ntawv cia thas nws thaum nws tuag. Yog li xav paub hais tias tus pog laus ntawv nws tus txiv tau nyiaj li cas, tus ntxhais tua nyiaj li cas thiab cov nyiaj ho tshuav li cas rau tus pog laus ntawv. Student works: $18,000(.25) = $4,500, $18,000 - $4,500 = $13,500. $13,500 (.20) = $2,700; $13,500 - $2,700 = $10,800; Money that left over $10,800.	cu, tpc	CU
16.2	Question 2: Ib tug lej ntxiv rau peb npaug ntawm qhov fraction $\frac{2}{3}$ yog muaj cuaj. Nrhiav tus lej ntawv. Student work: $x + 3 \cdot \frac{2}{3} = 9, x + 2 = 9;\ x = 7;\ 7 + 3 \cdot \frac{2}{3} = 7 + 2 = 9\ thiab\ 9 = 9.$	cu, tpc	CU
16.3	Question 3: Muaj ob tus lej sib lawv liav times ua ke yog muaj 5 npaug ntawm ob tus lej ntawv sib ntxiv rho 13. Nrhiav ob tus lej ntawv. Student works: $x(x+1) = 5(x+x+1) - 13, x^2 + x = 5(2x+1) - 13;$ $x^2 + x = 10x + 5 - 13;\ x^2x = 10x - 8;\ x^2 - 9x + 8 = 0;$ $(x-8)(x-1) = 0;\ x = 1\ los\ yog\ x = 8$ Ces ob tus lej ntawv yog 1 thiab 2 los yog 8 thiab 9.	cu, tpc	CU
16.4	Question 4: the sum of a number and ten times its reciprocal is seven. Find the number. Student works: $x + 10 \cdot \frac{1}{10} = 7;\ x + 1 = 7;\ x = 6.$ Check: $6 + 10 \cdot \frac{1}{10} = 6 + 1 = 7.$	cu, m, tpic	CU, M

Researcher interpretation and comment of the session: When student translated mathematical word problems written in Hmong language into mathematical equations, the student didn't miss anything such as mathematical symbols and operations until the last problem that written in English. When he translated the story problems written in Hmong language into mathematical equation, the student could apply the concept of mathematics by writing the mathematical equation in algebraic standard form. This

indicates that language was an issue for the student to learn mathematics in English. There were several words in English that caused the student misunderstood and misinterpreted the problem into mathematical equation. Although the student could read the problem, he might not able to translate the problem into mathematical equation because he translated a few time before getting a mathematical equation such as from English to Hmong language and from Hmong language to mathematical language (equation). The mistake took place in Hmong language because the Hmong language played a central role between English and mathematical language to the student.

Seventeenth Interview:

Section	Interpretation by Researcher	Initial	Final
17.1.1	Question 1: nees nkaus peb rho ib tus lej. (**Translation:** Twenty subtracts a number.) Student works: 23 – x. .	tlr, cu, tpc	TLR, CU
17.1.2	Question 2: Ib tus lej ntxib rau kaum xya. (**Translation:** A number add to seventeen.) Student works: x + 17.	tlr, pt, tpc	TLR, PT
17.1.3	Question 3: Tsib zaug ib tus lej. (Translation: Five times a number.) Student works: $5 \cdot x$	tlr, cu, tpc	TLR, CU
17.2.1	Question 4: peb caug ob faib rau ib tus lej. (**Translation:** Thirty-two divided by a number.) Student works: $32 \div x$.	tlr, cu, tpc	TLR, CU
17.2.2	Question 5: Rho ib tus lej los ntawv tsib caug ob. (Translation: Subtracted a number from fifty-two.) Student works: 52 – x.	tlr, cu, tpc	TLR, CU
17.2.3	Question 6: The numerator of a certain fraction is two more than the denominator. If $\frac{1}{3}$ is added to the fraction, the result is two. Find the fraction. Student works: $\frac{x+2}{x} + \frac{1}{3} = 2;\ 3x + 6 + x = 6x;\ \ 4x + 6 = 2;$ 4x + 6 = 6x; 2x = 6; x = 3.	cu, tpc	CU

17.3.1	Question 7: If a certain number is added to both the numerator and denominator of the fraction $\frac{7}{9}$, the result is $\frac{5}{7}$. *Find the number.* Student works: $x + \frac{7}{9} = \frac{5}{7}$; $x = \frac{5}{7} - \frac{7}{9}$; $\frac{45}{63} - \frac{49}{63}$; $x = -\frac{4}{63}$	pt, m, tpic	PT, M
17.3.2	Question 8: The product of two consecutive even integers is ten less than five times their sum. Find the two integers. Student works: $x(x+2) = 5x - 10$; $x^2 + 2x = 10 - 5x$; $x^2 + 7x - 10 = 0$; *or* $x(x+2) = 10 - 5x$; $x^2 + 2x = 5x - 10$; $x^2 + 3x - 10 = 0$	cu, m, tpic	CU, M
17.3.3	Question 9: Billy's mother has $25,500 in her account. She decides to take 2/5 of the money to Billy, and she gives 1/3 of what has left to her daughter. How much money does Billy get? How much money does Sara, Billy's sister, get, and how much money left over for Billy's mother? Student works: $\frac{25{,}500}{\frac{2}{5}} = 25500 \cdot \frac{5}{2} = 63{,}750\ Bill.$ $63{,}750 - 25500$ $= -38250\ mistake.$ $25500x\left(\frac{2}{5}\right)$; $5\sqrt{25500} = 5100x2 = 10200.$ $25500 - 10200$ $= 15300\ Billy$; $15300x\left(\frac{1}{3}\right)$; $3\sqrt{15300} = 5100\ daughter$; $15300 - 5100 = 10200\ mother.$	cu, tpic, tpc	CU

Researcher interpretation and comment of the session: It seemed that the student had difficult time to translate those application problems that written in English than those application problems that written in Hmong language. When the student translated word problems written in Hmong language, he applied the concept of mathematic, variables, and operations correctly. Also, he solved the equations step by step without any mistake. He didn't hesitate, and it seemed that he understood and felt confident a lot about his performance. However, he didn't confident about his English translation. For example, the student had two equations for one particular phrase that written in English. This indicates that he had problem with language, English. He didn't understand about every piece of information from the passage. Sometimes he understood it, but he could not

combine all the information together to get the correct mathematical equation. As for the student translated mathematical word problems that written in English, he used both procedural thinking and conceptual understanding to overcome the problems. He hesitated about his translation.

Last Interview:

Section	Interpretation by Researcher	Initial	Final
18.1	Question 1: One number is two more than twice another. Their product is two more than twice their sum. Find the numbers. Student works: None, can't come up with an equation.	m, tpic	M
18.2	Question 2: The sum of two numbers is 13. Their product is 40. Find the numbers. Student works: 8 + 5 = 13 and 8x5 = 40	pt, m, tpc	PT, M

Researcher interpretation and comment of the session: The student cannot translate the word problem that has at least two different operations at the same time into mathematical equation, but it didn't mean that he would not able to translate every story problem that contains at least two different operations into mathematical equation. The problem was involved language, and it showed that language was an issue for the student. If the word problem was writing very straight forward similar to Hmong language and the language wasn't too difficult, the student could translate into equation and solve to get the answer. For example, he just provided 8 and 5 for question number 2. This indicates that the student was depending so much on Hmong language. If the problem was similar to Hmong language, the student forgot to use mathematical concept to come up with mathematical equation before getting the answer. It showed that the student used only procedural thinking and memorization when the story problems were very simple and straight forward similar to Hmong language.

Mathematical problems	Correct	Incorrect	Total
	20	11	31

Total mathematical corrected problems	Left to right translation	Not left to right translation
20	16	4