AN ABSTRACT OF THE THESIS OF

Julissa Valenciano for the degree of Master of Science in Mathematics presented on September 1, 2020.

Title: Teaching Mathematics to International Students in Higher Education

Abstract approved:

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Mary Beisiegel

Institutions of higher education have experienced a rapid increase in international student enrollment within a short period of time, especially in mathematics classrooms. It is therefore important for instructors to have the knowledge and skills to support international students in the learning of mathematics. There are few research studies of the experiences of faculty teaching mathematics courses to international students, a gap that serves as a motivation for this study. The purpose of this study is to explore the experiences of mathematics instructors when assigned to teach courses for international students. In particular, this study explores how instructors perceive and work with language barriers that international students encounter in the classroom as they learn mathematics while they are in the process of also learning English. Interviews with instructors teaching mathematics for international students were analyzed. The themes identified in this study highlight the challenges encountered by instructors, the teaching adjustments made by instructors, and instructors' perceptions about the differences in classroom culture.

Teaching Mathematics to International Students in Higher Education

by
Julissa Valenciano

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Presented September 1, 2020
Commencement June 2021

Master of Science thesis of Julissa Valenciano presented on September 1, 2020

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Julissa Valenciano, Author

ACKNOWLEDGEMENTS

I gratefully acknowledge the support and guidance of my thesis advisor, Dr. Mary Beisiegel. Without her encouragement, valuable advice, and profound belief in my abilities, this thesis would have never taken shape. Along all, I owe a deep sense of gratitude for her guidance to overcome all the difficulties I encountered as a graduate student, instructor, and researcher. I also extend my sincere thanks to committee members, Dr. Thomas Dick, Dr. David Pengelley, and Dr. Kelly Riedinger for their support and feedback on this thesis.

I am extremely grateful to my parents, Maria and Fernando, for their unconditional support through the completion of this thesis and for teaching me the beauty of education as well as the product of hard work. I would also like to thank my siblings, Cesar, Samantha, and Brissia, who serve as my inspiration to work towards building a meaningful life for future generations. I wish to thank my best friend, Christian Guerrero, for his encouragement and constant visits, especially at times when things were tough.

Foremost, I thank God for granting me the strength, ability, and opportunity to proceed through my graduate studies successfully. I am grateful for all that He has provided throughout this research project, and undeniably, throughout my life.

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Chapter 1: Introduction

Institutions of higher education have experienced a rapid increase in international student enrollment within a short period of time. In the 2018-19 academic year, the United States experience a record high of 1,095,299 international students enrolled in institutions of higher education (Institute of International Education, 2019). According to the Open Door Report from the Institute of International Education (2019), the number of international students has increased by 62.2 percent since the 2008-9 academic year. Currently, the international student population represents about 5.5 percent of the total student population of institutions of higher education in the United States (Institute of International Education, 2019). It is important to recognize that the international student enrollment increase does not simply increase class sizes. The presence of multicultural and multilingual students changes the nature of classrooms, creating new opportunities and challenges to students, faculty, and staff.

Among the international student population at U.S. campuses in the 2018-19 academic year, students from China, India, South Korea, and Saudi Arabia represented 60.3 percent of the international student population. While students from a handful of countries make up the majority, international students are considered the most diverse group in institutions of higher education. Not only do they represent over 224 countries and regions of the world (Institute of International Education, 2019), but they also differ with respect to their racial and ethnic identifications, cultural norms and customs, and linguistic backgrounds (Hanassab, 2006). Among all international students, 51.6 percent pursued STEM fields with Engineering,

Mathematics, and Computer science being the largest academic fields for international students (Institute of International Education, 2019). Students interested in STEM-related fields are required to take courses in mathematics and succeed in them in order to earn degrees in STEM. How mathematics faculty staff in post-secondary institutions can support international students in their classrooms is thus an on-going point of interest and the motivation for the study described in this thesis.

'Internalization' refers to the process of integrating an international, intercultural, or global dimension into the purpose, functions, or delivery of higher education (Knight, 2003). More specifically, part of the internalization process is the integration of the international student population into the mission and values of post-secondary institutions. Internalization is impossible without the engagement of faculty (e.g., professors at any rank and fixed-term instructors). Researchers speculated that faculty may be the most influential person in affecting international students' academic experiences both negatively and positively (Glass, Kociolek, Wongtrirat, Lynch & Cong, 2015; Jin & Schneider, 2019). However, the role of faculty in internalization has not been the subject of extensive research. Several investigators have described the challenges, performance, and possible disadvantages of international students in post-secondary mathematical courses (Barton, Chan, King, Neville-Barton, & Sneddon, 2005; Choi, Milburn, Reynolds, Marcoccia, Silva, & Panag, 2013; Mestre, Gerace, & Lochhead, 1982). Because international students' experiences are directly influenced by teaching practices used by faculty, I conclude that research must seek to understand faculty members' interactions with and teaching of mathematics to international students.

In particular, I seek to understand how mathematics faculty perceive and work with international students, multilingual classrooms, and how faculty perceptions influence their pedagogical practices. Findings indicated that international students who are English as an Additional Language learners (hereafter referred to as EAL) struggle with learning mathematics in English at an undergraduate level beyond what was originally thought to be a K-12 concern (Barton et al., 2005). By using a qualitative approach and collecting data through interviews and class observations, I am able to understand how the presence of multicultural and multilingual students changes the nature of instructors' teaching practices.

In Chapter 2 of this thesis, I provide a literature review aiming to understand the experiences of international students in post-secondary institutions as well as faculty experiences teaching mathematics to international students. In Chapter 3, I describe the methods I used to recruit participants in this study, collect data, and analyze the data through the use of thematic analysis (Braun & Clarke, 2006). The methods of this study were determined according to my research questions presented at the end of Chapter 2. I then present the results from the analysis and the themes that emerged from the data on Chapter 4 of this thesis as well as a discussion of the results in Chapter 5. At the end of Chapter 5, I offer recommendations for faculty when assigned to teach mathematics courses to international students. All materials used for data collection can be found in the appendices at the end of this thesis.

Chapter 2: Literature Review

The research on the *experience of faculty* assigned to teach mathematics courses to international students at a post-secondary level is minimal compared to research on the experience of international students in post-secondary mathematics courses in the United States. Long ago, researchers like Knudson (1956) began identifying different ways graduate programs can better serve and support international students according to their reported experiences in post-secondary institutions as a whole. More recent studies have now turned their focus specifically on the experiences of international students in post-secondary mathematics courses as well as the influence of a second language in mathematical performance (Barton et al., 2005). Conversely, there are minimal investigations of faculty views of internalization (e.g., the increase of international students in their classes) and the pedagogical approaches they choose when teaching mathematics to international students.

I organized this chapter into different sections. First, I focus on the experience of international students in post-secondary institutions as a whole. Then I segue into the experiences of international students specifically in post-secondary mathematics courses. I then describe the research that investigates the experiences of faculty teaching international students in post-secondary institutions. Note there are few research studies of the experiences of faculty teaching mathematics courses to international students, and this gap in the literature serves as a motivation for this study. Finally, I introduce my research questions that address how faculty interact with and teach mathematics to international students, as well as how faculty address

teaching within a multilingual classroom.

2.1 International students in post-secondary institutions

Several research studies focused on understanding and documenting possible factors that could predict the success of international students in post-secondary institutions in the United States. Some studies were designed to examine the relationship between the Test of English as a Foreign Language (TOEFL) scores and the academic success of students in higher education (Al-Musawi & Al-Ansari, 1999; Vinke & Jochems, 1993; Wait & Gressel, 2009). Prior to being admitted to post-secondary institutions in the United States, international students are required to take the TOEFL; a test of student writing, reading, listening, and speaking English proficiency (Wait & Gressel, 2009). The motivation for examining TOEFL scores was based on the assumption that the English language can be a factor affecting the performance of international students whose native language is not English. Several studies disagreed about the effectiveness and productiveness of the TOEFL in predicting international students' success. So, while it might be useful to understand and assess English language skills possessed by international students, it does not necessarily serve as a predictor of a student's future academic success.

For example, Vinke and Jochems (1993) identified a relationship between the TOEFL score and academic performance for Indonesian engineering students enrolled at a postgraduate program. They indicated that TOEFL scores increase the chance of being academically successful only with TOEFL scores of approximately 450 or above (Vinke & Jochems, 1993). Another study found TOEFL sub-section components scores to be highly correlated with student's performance in English

courses but less associated with overall university GPA (Al-Musawi & Al-Ansari, 1999). A more recent study conducted by Wait and Gressel (2009) found that increases in the TOEFL scores can affect the performance of engineering students in English, History, and Social Sciences courses. However, the relationship between higher TOEFL scores and student performance in engineering courses is weak (Wait & Gressel, 2009). The results from these studies indicate the relationship between the TOEFL score and academic performance likely depends on the level of English language abilities required for academic success in different courses.

In order to understand how post-secondary institutions could design programs and services for international students, researchers focused on understanding the institutional environmental adjustment difficulties of international students (Becker, 1968; Knudson, 1956; Poyrazli & Grahame, 2007; Selby & Woods, 1966; Stafford, Marion, & Salter, 1980). Knudson (1956) conducted one of the first studies designed to investigate international students' attitudes about how well their personal goals and orientation needs were being met at a college institution in the United States. Similarly, other researchers investigated patterns of international student adjustment in different selected areas such as homesickness, English language fluency, and social relationships (Poyrazli & Grahame, 2007; Selby & Woods, 1966; Stafford at el., 1980).

Researchers reported that international students experience pressure and lack of social structure, prohibiting them from becoming insiders in these "high-pressure" universities in America. International student experiences include feelings of isolation due to difficulties socializing and creating relationships with American students

(Knudson, 1956; Poyrazli & Grahame, 2007; Selby & Woods, 1966). For example, interviews of international students describe the U.S. academic system as a competition associated with selfishness, ego-centered preoccupations and the elimination of concerns for others (Selby & Woods, 1966). In addition, Knudson (1956) reported that the majority of the international students recommended that they receive additional courses in the English language, a stronger extensive orientation program, and an industrial internship opportunity.

Several studies considered a variety of sub-groups of the international student population in order to better understand their adjustments and experiences in post-secondary institutions in America. These studies consider sub-groups of international students based on their level of studies and country of origin (Stafford at el., 1980; Yeh & Inose, 2003). According to the study conducted by Stafford at el. (1980), finances were the greatest problem for undergraduates, while homesickness was most difficult for graduate students. In addition, there is evidence that students' country of origin influences their adjustment to their host country. For example, European students report experiencing less acculturative stress than students from Asia, Central/South America, and Africa (Stafford at el., 1980; Yeh & Inose, 2003). More specifically, students from the Orient and Southeast Asia reported greater difficulty with English while difficulty with future vocational plans were reported by students from India and Pakistan (Stafford at el., 1980). In contrast to the design of traditional institutional international student services, these studies indicate that the needs and concerns of all international students are not the same and are not being met.

Along the same lines, Kim (2012) explored the identities and self-perceptions of Korean graduate international students studying in the U.S. This study reported how students expressed a sense of inferiority compared to American students because of their English language ability. Students described their new self-image using words such as “limitations” and “handicap” as they described recognizing they did not perform at the level they were accustomed to in their Korean universities (Kim, 2012). Similarly, Valdez (2015) focused on better understanding the experiences of undergraduate Chinese students, the largest subgroup of international students in the U.S. In this study, Chinese students expressed how American students and faculty members often do not have favorable perceptions of Chinese international students. For example, Chinese international students believed faculty and American students made assumptions about their unwillingness to participate in class discussion and group projects, and profile students in issues of academic dishonesty (Valdez, 2015). These studies highlight how embedded cultural assumptions can influence how we perceive others as well as ourselves, especially in higher education institutions.

In the early years of research on international students at post-secondary institutions, researchers were mainly focused on understanding the adjustment levels and challenges of international students at universities in the United States. First, international student experiences were investigated by considering international students to be a single group. However, more recent researchers focused on how international student experiences in college institutions differ based on their country of origin. The assumption that mathematics is less difficult for international students because it is a topic “based on a language of numbers” has led to mathematics to be

one of the least researched disciplines in the experiences of English language learners. In the next section, I will be discussing some of the research focused on international students in mathematics classrooms in the United States, and the influence English as an Additional Language can have in the mathematical performance.

2.2 International students in U.S. mathematics courses

In the post-secondary classroom setting, a large amount of the international student population arrive at U.S. institutions while they are still in the process of learning English. In this section, I will be presenting some of the post-secondary level research studies focusing on the difficulties students who have English as an Additional Language (EAL students). Mathematics is not "language-free" and the vocabulary, syntax, and discourse can present challenges to EAL students in post-secondary institutions (Barton & Neville-Barton, 2003). Garris and Kerper-Mora (1999) described mathematics as a highly compressed form of communication where a single symbol can present several words; therefore, the learning and teaching of mathematics relies heavily on the oral explanation of concepts. The majority of research studies of international students in post-secondary mathematic courses have focused on the influence language has on mathematics learning, especially when instructions takes place in the student's second language (Barton & Neville-Barton, 2003; Gerber, Engelbrecht, Harding, & Rogan, 2005; Mestre et al., 1982).

Several studies have investigated the impact of learning mathematics in a second language, specifically in English. Some researchers designed studies with the purpose of comparing the performance of monolingual and bilingual students in post-

secondary mathematical courses. Outcomes of these investigations were that the performance of monolingual bilingual students, measured via mathematical translation skills (Mestre et al., 1982) and performance on mathematical tests (Choi et al., 2013), is strongly correlated to language proficiency. In the study conducted by Mestre et al. (1982), reading comprehension proficiency and the ability to translate from syntactic to symbolic representations were compared among a group of monolingual students and a group of bilingual engineering students. Mistakes among both groups showed greater adverse effects on bilingual students. For example, bilingual students were more prone to making errors due to language misinterpretation such as representing the sentence, "six times as many students as professors" as $6S = P, 6S = 6P$, or $6S + 6P$ (Mestre et al., 1982).

Along the same lines, Choi et al. (2013) investigated whether language in mathematics test items has disproportionately negative effects on EALs' performance in comparison to non-EALs. Using a mathematics task focusing on four language contexts and an additional five mathematics items designed to require a minimum amount of language, the study concluded that there are possible language biases in mathematical problems disadvantaging EALs. On the other hand, the items designed to require a minimum amount of language showed no significant difference in performance between the two groups (Choi et al., 2013).

Based on findings from a study with secondary school learners in England, Dawe (1983) found that a student's first language competence is an important factor in the ability to reason in mathematics in English as an additional language. Barton and Neville-Barton (2003) considered that the levels of proficiency in *mathematical*

English, not just proficiency in English, is the most important factor in the learning of mathematics for international students. Their study was designed to investigate the performance of EAL international students in post-secondary mathematics classrooms. The study found that, because of the lack of understanding of mathematical texts, EAL students were at a 10% disadvantage in comparison with English as a first language students. In addition, although written mathematics can take the form of text, symbols, diagrams, or graphs, EAL students stated they preferred mathematical symbols, and diagrams, or graphs to express themselves (Barton & Neville-Barton, 2003).

Motivated by these ideas, Gerber et al. (2005) began to explore the influence of second language in a post-secondary mathematics course in South Africa where students had the choice to attend mathematical lectures in English or Afrikaans. This study found that there is no significant difference in the performance of the group of all students attending first language lectures and the groups attending second language lectures. The researchers indicated that linguistic bilingualism is not sufficient for ensuring achievement in mathematics (Gerber et al., 2005). In other words, students who are linguistically bilingual are not necessarily cognitively bilingual. Unexpectedly, EAL students who had been in New Zealand for six years or more reported having significantly lower levels of mathematical understanding than EAL students who had recently arrived in New Zealand (Barton et al., 2005). Researchers have noted there may be a level of linguistic competence that EAL students must reach in order to avoid cognitive deficits (Barton & Neville-Barton, 2003; Gerber et al., 2005; Mestre et al., 1982). The level of linguistic competence

necessary to learn mathematics at a post-secondary level has not been defined. However, the influences of English as an additional language in mathematical learning has been documented as one of the most influential factors.

Moreover, a study was designed to examine EAL students' language requirements at year 3 level of mathematics at a post-secondary institution (Barton et al., 2005). In this study, comparisons were made between a higher English proficiency group and the lower English proficiency group of EAL Chinese speaking students based on a language-based mathematics test. Results confirm that EAL students were unaware of any difficulties of language or any disadvantage due to language when studying mathematics. However, among the lower English proficiency group, students were presented two different statements of the same theorem and were unable to identify that the two statements represented the same theorem. Findings indicated that EAL students struggle with learning mathematics in English at an undergraduate level more than what many have been anticipated by many (Barton et al., 2005).

The influence of language on mathematical learning not only refers to the influence of the student's home language, but also refers to factors like the effectiveness of communication between faculty and student, the student and the written text, and the linguistic skills of the professor (Gerber et al., 2005). Students' ability to articulate their strategies, discuss concepts, and communicate mathematics has become the central focus in mathematics, and mathematics education. The teaching practices that are required to reach such mathematical abilities puts pressure on students from groups that are in the process of learning English. The teaching and

learning of mathematics in the students' non-native language requires additional and complex demands on faculty and students (Mestre et al., 1982). In the next section of this thesis, I will be discussing some of the research on faculty views and perceptions of international students, and some of the teaching approaches that are recommended for teaching international students.

2.3 Faculty teaching international students

Minimal research has been conducted with a focus on understanding the experiences of faculty teaching international students at post-secondary institutions in the United States. Understanding faculty perceptions of international students' academic performance and their instructional techniques is essential in order to improve the teaching and learning in this area. In this section, I will describe studies conducted to understand faculty beliefs and perceptions towards international students as well as how faculty background characteristics may shape their attitudes and beliefs about international students. Because few studies have investigated the faculty experiences teaching international students in the United States, I included studies conducted in other countries.

A small body of survey and interview-driven research investigate instructors' beliefs and perceptions towards international students. A common theme across these studies (Gallagher & Haan, 2018; Gallagher, Haan, & Lovett, 2020; Samuelowicz, 1987) are some of the negative perceptions university faculty have of international students' academic skills. In the study conducted by Gallagher and Haan (2018), the majority of the faculty participants constantly described students as being deficient, vulnerable, and inadequately supported. On the other hand, faculty participants in this

study expressed a strong preference for international student support provided outside of class time and emphasized that their university was not doing enough to provide that support (Gallagher & Haan, 2018).

In order to develop a positive learning experience for all, researchers investigated the learning difficulties of international students as seen by the faculty in post-secondary institutions compared with the perceptions held by international students (Gallagher et al., 2020; Samuelowicz, 1987). Similar to other studies, language was seen again as a major challenge facing international students by both faculty and students at a university in Australia (Samuelowicz, 1987). On one hand, the majority of the faculty viewed the lack of poor development of analytical and problems solving skills as a consequence of poor or inappropriate study skills adopted by international students. On the other hand, international students stressed that the differences between tertiary education systems required them to adopt different learning approaches due to different teaching methods employed by educators (Samuelowicz, 1987).

Similarly, Gallagher el at. (2020) found a mismatch of perceptions held by faculty and international students at a post-secondary institution in the United States. Most faculty believed international students' English proficiency was poor whereas students rated their language skills as adequate for the level of their courses. It is important to note that the fact that international students are aware of their need to adopt new learning approaches does not necessarily mean they know how to develop new learning approaches.

In contrast, faculty across different disciplines have expressed overall positive attitudes towards the increasing numbers of international students in their classrooms. Faculty participants in post-secondary institutions expressed they valued the exposure to different cultures, and the students' potential to provide an international perspective to the classroom (Haan, Gallagher, & Varandani, 2017; Jin & Schneider 2019; Trice, 2003). However, even though faculty participants expressed positive views on the increasing numbers of international students, they also expressed reservations adapting their teaching practices for linguistically diverse students (Haan et al., 2017). In the study conducted by Jin and Schneider (2019), faculty participants framed their own teaching challenges in terms of students' challenges such as students' English proficiency and cultural differences. In other words, the majority of faculty welcome international students, but also believe some of the students' characteristics could cause challenges for teaching.

Furthermore, researchers consider how faculty members' background characteristics may shape their attitudes and beliefs about international students (Jin & Schneider, 2019; Wang & BrckaLorenz, 2018). For example, Jin and Schneider (2019) found that White faculty are more likely than Non-White faculty to express strong appreciation for cultural differences, but they are also more likely to identify students' English language skills as one of the biggest challenges. In addition, a survey completed by over 14,500 faculty members in the United States and Canada, Wang & BrckaLorenz (2018) found that the engagement of faculty and international students revolved around faculty members' racial/ethnic identification. It was found that Asian, Pacific Islander, African American faculty were more likely to participate

in more student-faculty interaction with international students than their White colleagues (Wang & BrckaLorenz, 2018).

In more recent studies, researchers started to examine the pedagogical practices used by instructors teaching international students at post-secondary institutions. For example, there was a study focused on pedagogical practices used by instructional faculty that facilitate international and domestic students' interactions at two universities in the United States (Yefanova, Montgomery, Woodruff, Johnstone, & Kappler, 2017). Findings indicate that instructors who planned for, and carefully structured cross-national interaction appeared to recognize the greatest benefits from such interaction. As a result, students were more likely to develop an appreciation for cross-national interactions in the classroom (Yefanova et al., 2017).

Along the same lines, Sawir (2011) conducted a study examining if and how instructional faculty change their teaching practices due to the presence of international students. Some instructional faculty indicated a greater awareness of the presence of intentional students and made adjustments in their teaching. The most frequent adjustment made by instructional faculty focused on addressing the language difficulties of international students. On the other hand, other instructional faculty made no distinctions between international and domestic students and did not make any special adjustments to their teaching (Sawir, 2011). In other words, one approach valued sameness, while the other valued difference between international and local students.

After an intense literature search and review, it became clear that there is minimal research that has investigated the experiences of faculty teaching

mathematics to international students at the post-secondary level. This could be due to the false belief that mathematics is a technical and universal subject. The gap in the literature serves as the motivation for this study. In the next section, I will explain the purpose of my study and the questions I hope to address after conducting the study.

2.4 Research questions

The research on the experiences of faculty teaching mathematics to international students at the post-secondary level seems to be only beginning. An exploration of the research focused on the experiences of international students at post-secondary institutions in the United States was completed. I addressed some of the challenges international students face as they adjust to their new academic environment in the United States especially in a mathematical class setting. In particular, international students' English language proficiency has been identified as one of the biggest challenges affecting their mathematical understanding and performance.

The research in the most current decade has addressed the perceptions and attitudes that faculty have towards the increase of international students at post-secondary institutions courses. However, there is minimal research on the teaching methods faculty use to teach international students. It is my hope that the research continues to explore how faculty can be supported in order to provide a rich experience to international students in their classrooms. The purpose of my research is to explore and understand the experiences of faculty teaching mathematics to international students. My study aims to answer the following questions:

1. What are the experiences of mathematics instructors when assigned to teach a course for international students?
2. How do mathematics instructors perceive and work with a language barrier in mathematics classes?

The questions of this study were deliberately broad to capture a wide range of experiences of the participants without any restrictions on the type of experiences participants could share during the study. This study was designed to learn about mathematics instructors' experiences in planning and delivering instructions, engaging international students in the classroom, evaluating the performance of international students, and how they adjust their teaching practices based on their interactions and encounters with international students.

Chapter 3: Methods

In this section, I describe in detail the methods that were employed to recruit participants in this study and the instructors who volunteered to be part of this study. I will also explain the data that was collected and the data collection methods. Lastly, I will explain the process of analyzing the data.

3.1 Recruitment and participant information

The data of this research study was collected over a 10-week term at a public university on the West coast of the United States. For this study, I sought individuals who were currently faculty or graduate students who were teaching mathematics courses to international students at a public university to participate in one-to-one interviews and observations. The purpose of this study is to gain an understanding of the instructors' experiences when assigned to teach a mathematics course to international students.

At this particular university, there is an international student program that provides credit-bearing courses, language development, academic advising, and community engagement. In addition, an undergraduate pathway program is carefully designed to help international students through the first year of the undergraduate degree program. The international student program is comprised of credit-earning courses in mathematics, science, and writing. The enrollment in these courses is low compared to the courses that are offered to the general population of students. Instructors and graduate students from the mathematics department are assigned to teach courses to students in the international program. These courses are composed of international students who are in their first or second year of undergraduate studies.

Before the beginning of the term, I contacted everyone who had been assigned to teach a mathematics course for the international student program according to the university class schedule. The list of mathematics instructors teaching international students included graduate students, part-time faculty, and full-time faculty members at the mathematics department. I sent an email to everyone teaching mathematics courses for the international student program to inform them about the purpose and the protocols for this study. The recruitment letter that was sent to prospective participants can be found in Appendix A.

By the beginning of the first week of the term, a total of six people self-selected to participate in the study. All participants explained that they did not receive any special training before teaching a course to international students. In addition, most of the participants had little experience teaching mathematics to international students. In the table below, there are relevant personal and academic attributes for all six participants in this study.

Table 3.1 Participant Information

Pseudonym	Multilingual	Previous classes	Current class
Emily	English Only	Pre-requisite for College Algebra	Trigonometry
Mary	Yes	Pre-requisite for College Algebra College Algebra Trigonometry	College Algebra
Isabel	Yes	College Algebra	Differential Calculus
Chris	English Only	No previous experience	College Algebra
John	English Only	No previous experience	Integral Calculus
Juli	Yes	College Algebra	Trigonometry

After the participants expressed interest in the study, participants' names were

replaced with research identification numbers and were later assigned a pseudonym for confidentiality purposes. Before the first interview, I sent a copy of the verbal consent form including information about the purpose, protocols, potential risk, and confidentiality of this study. The copy of the verbal consent form sent to all participants can be found in the Appendix B. It is possible that the time commitment required of the instructors could have influenced their decision to self-select to participate in this study.

This study uses a qualitative approach to learn about faculty beliefs about language, faculty instructional choices, and preparedness when teaching a mathematics course to international students. The study consisted of a 40-minute introductory interview, up to three classroom observations followed by 30-minute interviews, and an end-of-term interview. The interviews took place at different locations around the university campus for confidentiality purposes. The participants were not paid or compensated in any way for their involvement in this study.

All six participants completed the study from beginning to end. For the purpose of this thesis, I decided to analyze the data acquired from interviewing Emily, Mary, and Isabel. These participants demonstrated thoughtfulness and awareness of language barriers when teaching international students. All these participants had experiences teaching at least one course to international students in the past. In addition, Mary and Isabel had experience learning a second language and study abroad experiences in a country outside the United States. These three participants demonstrated an awareness of the importance of making teaching

adjustments when teaching international students. For example, Isabel and Emily explained how they first became aware of the language barrier:

> Isabel: One of my students came up and said, "I don't know what this word," and it was tangent. I was like, "That's totally fine. We'll get into that more." The next one was secant, "Totally fine. We'll get into that more." Then the last one was rock, like, "Oh, no." I feel like the rock is very, like knowing that, it's, it's not important that it is a rock.
>
> Emily: Last term there was a question on a quiz where every single student got it wrong in my class. It was because they all miss interpreted the problem in the same way. "Graph the distance that this person had travel over time. Mary walked to this store but on the way she ran into her friend…" They all thought that meant she ran to her friend.

In comparison, the other participants, John and Chris, believed that all students, domestic and international, are the same and, as a result, they did not consider the presence of international students to have any impact on their teaching practices. As a result, John and Chris did not make special accommodations for international students. Below are excerpts from these two participants that show this idea.

> John: It's just the clarification that this is what we're doing. I think some of them were learning some refinements of English. They all seemed to have the English language down well enough that we didn't ever reach for other tools to communicate. We seemed able to communicate functionally and fluidly.
>
> Chris: I think we get really hung up on that English is their second language, but most of these students have been learning English since they were kids anyway. So they are pretty, they're perfectly fluent. So I guess I would take that knowing that, take that another classroom that international students aren't, it's not that much different teaching them than other students.

In addition, Juli had a small class of seven students with extremely low attendance to class. It was difficult for Juli to experience and study language issues with one or two students present. Typical comments were:

> Juli But when you only have seven total and only three show it up and they're all in really different places. Like not only do they not want to necessarily talk to each other, but I'm not sure if at that point it was really beneficial to anybody. Most of my issues have to do with the seven people than they being international, I think.

Throughout the study, Juli indicated she had difficulties with this particular class since only two students would typically come to class. She explained that it was difficult for her to utilize an active learning approach and acquire feedback from her students.

For the most part, John and Chris did not make any changes to their teaching practices when teaching international students. These two participants provided little insight into how instructors acknowledge and work with international students. Because of low attendance, Juli also did not provide insights on how instructors perceive and work with international students. Thus, because my research questions are focused on whether and how mathematics instructors adjust their teaching practices and attend to language issues, I decided to only focus on the experiences reported by Emily, Mary, and Isabel, who demonstrated adjustments to their teaching and awareness of language issues when teaching mathematics to international students.

3.2 Interview and class observations protocols

All six participants were interviewed four times over the course of a 10-week term. In past research had not explored how mathematics instructors adjust their

teaching practices and address language barriers. The purpose of the interviews was to let the participants tell their own story about the challenges they face in the classroom, how they adjust their teaching practices and address language barrier in the classroom. Interview questions focused on how instructors talked and wrote content learning; how instructors utilized different linguistic forms and functions in particular ways to communicate; and how instructors engage their students, present concepts, and facilitate class discussions. I also conducted class observations with a follow-up interview. The purpose of the observations was to understand how participants presented the mathematics and how they used the teaching practices described during some of the individual interviews. The follow-up questions asked participants to explain their attitudes about the language use during the lesson, and reflect about the teaching practices utilized by the participants.

I aimed to schedule the interviews with participants so that they occurred during the same week of the term, as close together as possible. The purpose of this was collect data about the participants' experience according to the week of the term. However, flexibility to meet during a different week was given to participants who were sometimes unable to meet the same week of the observation. Each interview was audio recorded for later analysis.

3.2.1 Initial interview

During the first week of the term, I contacted each participant to determine their availability to complete an approximately 40-minute introductory interview. I scheduled the first interview with each of the six participants during the second week of the term. The first interview was designed to learn about the participants' teaching

practices and teaching style. They were also asked to comment on any challenges they expected when teaching international students, and also their perspectives concerning whether or not they have to make adjustments to their teaching practices. Interviewees were also asked to provide background information such as length of time teaching, experiences living outside of the United States, current teaching responsibilities, knowledge of other languages, training in teaching, and supervising international students.

First, participants were asked about whether the current 10-week term was their first time teaching a mathematics class for the international student program. In addition, participants were asked about what other courses they had been an instructor for including courses other than mathematics courses. These questions were posed in hopes of determining the teaching experiences they had previous to being assigned a mathematics course for international students. I then asked them to describe their teaching style, class norms and expectations, as well as other details of their teaching practices. These subsequent questions were aimed at determining participants' thoughts about their role as instructors.

The participants were asked about their experiences with different cultures and countries as well as their proficiency with any languages other than English. In addition, participants were asked "When interacting with a person from a different culture than your own, how do you ensure that communication is effective?" These questions were posed to better understand the participants' experiences with people from different backgrounds. Finally, a set of questions was asked about what kind of qualities international students look for in teachers, as well as any possible challenges

expected to have when teaching international students and how they plan to overcome those challenges. These questions were asked to identify participants' initial expectations and preparedness during the first few weeks of teaching mathematics at the international student program. The copy of the questions from the initial interview can be found in Appendix C.

3.2.2 Class observation followed by interview

In addition, up to three classroom observations followed by 30-minute interviews were conducted with each participant. The observations were included in this study to provide valuable insights into the teaching styles of the instructors and how they covered the content of the courses. The class observations allowed me to ask specific questions about the role(s) of the instructor in the classroom, the types of materials provided and used, and the participants' teaching practices they described in the first interview. The class observations were used as a source to create questions that were addressed with participants during the follow-up interview. Therefore, the class observations and the interviews were complementary to each other.

The classroom observations were conducted during the third and sixth week of the term. Each participant was emailed ahead of time asking for permission to observe their class during those weeks of the term with an explanation of the purpose of observing. I clarify that I was not visiting their classroom to make a judgment of the teaching practices employed by the participants. The participants provided their class meeting information and welcomed me to visit their class during any of those days. I completed a total of two class observations with all 6 participants. An additional third observation was completed during the eighth week of the term with

three of the participants, Isabel, Mary and Emily, as they demonstrated an awareness and used specific teaching practices as the 10-week term went by.

An observation tool was developed to catalogue teaching behaviors that are known to make up high quality instruction when teaching English as an Additional Language students (EALs). The categories listed on the observation tool were motivated by the recommendations for meeting the challenges in developing mathematics instructions for EALs (Moschkovich, 2012). For example, the observation tool included note taking sections on the mathematical concept delivery form used, changes of form of delivery, verbatim conversations, nonverbal expressions, and gestures used by the instructor, opportunities for students to practice mathematical language, and instructor's appreciation of students' comments. The copy of the observation tool can be found in Appendix D.

After the first class observation, I contacted all participants to schedule the follow-up 30-minute interview. The follow-up interview was scheduled as close as possible to the date of the class observation. Most participants were able to meet for the follow-up interview within a week after the class observation. The first set of questions in this interview were unique for each participant focusing on what I had observed during the class visit. For example, Emily was asked about her choice on encouraging a student to ask a question in English when she was facilitating a class discussion. Another participant, Isabel, was asked about her persistence on getting students to talk to each other as they were working on an exercise.

In addition, this interview included questions about whether they felt like the language barrier was an obstacle during the lesson, and the strategies used to help

students become more confident with working with mathematics. Other interview questions were focused on participants' thoughts about student English proficiency, addressing students' English mistakes, and the language used in the textbooks, class activities and exams. Participants were also asked if there had ever been an occasion where they had trouble understanding a student's comment and how they managed to address the student. Finally, at the end of each follow-up interview, participants were asked if they wanted to add any thoughts about the observed lesson or their experiences teaching international students.

Similarly, I conducted another class observation with a 30-minute follow-up interview. As mentioned before, the first few questions were based on the class observation. Other interview questions were focused on participants' thoughts about student English proficiency, addressing students' English mistakes, and the language use in the textbooks. The copy of the questions of the first follow-up interview can be found in the Appendix C.

3.2.3 Final interview

The final interview was scheduled with all participants the week before final exams. During the final interview, all participants were asked the same questions. As mentioned previously, I competed a third class observation with three of the participants. For these three participants, there were two additional two questions asked on the last interview according to the observations made on the third class observations. The last interview was created for participants to reflect on their teaching experiences. Participants were asked about their expectations before teaching a course for international students, whether there were any adjustments to

teaching methods, and how they would employ what they learned in their future teaching practices. In addition, participants were asked how they supported students with a language barrier and what teaching practices they wish they had used. Finally, participants were asked about what recommendations they would give to an instructor teaching international students as well as what type of teaching training they would like to have received before teaching a class for international students. The copy of the questions from the final interview can be found in Appendix C.

3.3 Analyzing data

Once I transcribed all of the interviews, I was able to begin analyzing the data using thematic analysis; a method for identifying, analyzing, and reporting patterns (themes) within data (Braun & Clarke, 2006). An outline of the six phases of thematic analysis are provided by Braun and Clarke (2006) which guide my process of analyzing the data of this study. The table 3.2 below provides a summary of the phases of thematic analysis as well as a description on how I completed each phase.

Table 3.2 Stages of Thematic Analysis

Phase	Phase Description	Action taken
1	Familiarizing yourself with the data	Transcribed each interview myself; read and listened to the audiotape multiple times.
2	Generate initial codes	Indicated potential patterns and made notes to identify segments of data on printed copies of transcripts. Repeated process on computer, and created table with excerpts related to each code.
3	Searching for themes	Considered the relationship between each code. Re-arranged related codes on table to represent candidate themes.
4	Reviewing themes	Discarded some of the candidate themes. Broke down other themes into separate themes. Re-arranged data excerpts into the established themes.

5	Defining and naming themes	Analyzed data describing each theme and discussed how the theme relate to each other.
6	Producing the report	Discussed findings and drew conclusions based on the themes.

During Phase 1, I initially became familiar with the data set during the process of transcription. I emerged myself in the data by repeatedly listening to the recordings and actively reading the transcripts, searching for meaning and highlighting interesting ideas. In addition, I made notes of possible codes that could be further considered during Phase 2. It became evident that there were similar challenges experienced among the participants in this study; however, there were differences on the teaching adjustments made by each participant.

Before continuing to the next phase of thematic analysis, I first had to consider whether to take an *inductive* or *deductive* approach to the data set. Initially, I considered a deductive approach using the concerns-based adoption model (CBAM). The CBAM approach included a stage of awareness during which a teacher has either no interest in making use of an innovation. Next, the teacher becomes willing to considers the impact of the innovation as well as the management and consequences of such innovation. Finally, the teacher collaborates with other educators, and evaluated the impact of the innovation and possible changes. As I became more familiar with the data, I decided this model did not capture the data for this study since most of the participants did not consider a specific innovation or followed the changes processes described by this framework. I then decided to use an *inductive* approach for creating codes that emerged from the data, where I developed my own codes for analyzing the data based on reading the transcripts and finding similarities in the experiences of the participants.

During the second stage, generating initial codes, I used colored pens to indicate potential patterns and made notes to identify segments of data on printed copies of the transcripts. I repeated this step using a computer looking for new patterns and re-identifying the same patterns as before. I created a table consisting of the codes of any potential themes with excerpts from each of the transcripts. The codes that I identified aimed at understanding the participants' overall experiences teaching international students. Data extracts with codes applied were organized into a table as I read each transcript. For example, the code tittle "dilemma about the English only policy" was applied to data extract such as:

> Mary: In theory, it's a good idea because the international program is trying to help the students develop their English as much as possible. I think it's a good idea in theory. But in practice, what if you're learning a new math word for the first time and you have a question about it. If it's necessary to ask your Chinese friend, "Katie, like what is this in Chinese?" I don't think that's a bad thing.

Other codes included items like "Abandon teaching methods," "Challenges engaging students in group learning," and "Awareness of different student educational background." I created a total of 13 initial codes identified during the second stage of thematic analysis. The list of initial codes can be found in Appendix E.

After identifying initial codes, I began phase three of thematic analysis by searching for themes considering how the identified codes were related to each other. For example, I consider the codes "Focusing on speaking proficiency development," "English vocabulary development," "Instructor language adjustment," and "Instructor writing adjustment" to be related to *teaching adjustments* to overcome the language

barrier. Different codes were combined into themes while other codes that did not seem to belong to the main themes were separated into a theme called miscellaneous.

During phase four, I reviewed each candidate theme for possible changes in combining, refining, separating, or excluding data. For example, "Methods to assess students' knowledge in the classroom" was identified as a theme candidate. However, it became part of the theme "Supporting students' mathematical communication" since the techniques used to assess students' knowledge were a resource to support communication of mathematics. Throughout this phase, some data pieces were excluded since they did not contribute to any theme in a meaningful way. After completing this phase, I focused on defining and naming themes according to how participants described each of theme. There were three final themes extracted from the data: challenges faced by instructors, adjusting teaching methods, and differences in classroom culture. The table 3.3 below provides the codes and sub-codes identified in the data as well as a description each code and sub-code.

Table 3.3 Names and description of codes and sub-codes.

Code	**Sub-code**	**Description**
Challenges faced by instructors	Challenges with unfamiliar vocabulary	Difficulties with unexpected unfamiliar vocabulary that served as a distraction from the mathematical focus.
	Challenges engaging students	Difficulties with lack of attendance, students participating in-class discussions, and group activities.
	Challenges creating inclusiveness	Difficulties creating a space where all of the students felt included in the group learning activities.
Adjustment to teaching practices	Adjustments to verbal and written instructions	Modifications to language and writing in order to support students who entered the classroom with limited experience with the English language.

	Strategies for vocabulary development	Methods to identify and provide definitions of unfamiliar vocabulary before and during mathematical lessons.
	Supporting students' mathematical talk	Providing opportunities for students to practice communicating mathematics in formal and informal settings.
	Implementation of the English-Only policy	Dilemma on whether to adopt or abandon the English-Only policy
Differences in classroom culture		Attitudes and aware of different worldviews in the classroom, students' understanding of classroom culture and classroom norms and how these can influence students' behavior in the classroom.

In the next chapter, I describe in detail each of the themes extracted from the data. Additionally, I explore the relationships between each of the factors to better understand the experiences of mathematics instructors when assigned to teach a class of international students and how instructors work with a language barrier.

Chapter 4: Data Analysis and Discussion

In this chapter, I discuss the results from analyzing the themes presented in Chapter 3, as well as how the themes relate to each other. I provide extracts from the participants' interviews to illustrate how each theme emerged from the data collected in this study. It should be noted that I will be describing the patterns found from analyzing results from all three of the participants as opposed to each participant individually.

4.1 Challenges faced by instructors

During the initial interviews, I asked participants what challenges they were expecting when teaching mathematics to international students. Some of the participants had concrete answers to this question based on their previous teaching experience and the first week of teaching during the term of this study. As mentioned previously, the data was collected over a 10-week term while participants were in the process of teaching a mathematics course to international students.

Throughout this term, the participants struggled with similar challenges. Most of the challenges were attributed to difficulties with the language or as a consequence of students' low English competency. Among all the challenges identified by each participant, three challenges that were experienced by all three participants: challenges with unfamiliar vocabulary, challenges engaging students in group learning, and challenges creating inclusiveness.

4.1.1 Challenges with unfamiliar vocabulary

At the beginning of the study, participants described how they became aware of English language barrier in the classroom. The participants described how unfamiliar vocabulary served as a distraction from the mathematical focus during some of the lessons. Below is a quote from Isabel that illustrates this:

> Isabel: We might be talking about a cone with coffee draining out of it. We might be talking about a rancher. Like what is a corral? Like there's a lot of weird words that come up, especially with optimization problems. Like who cares about cylinders. We haven't mentioned cylinders for the whole term and suddenly we're talking about volumes and shapes of objects, and what is dimension? Like it just brings up a whole lot of new vocabulary. I think it can be hard.

In this excerpt, Isabel expressed how her students became distracted from the goal of the optimization exercise. On this occasion, Isabel explained how her students focused on the unfamiliar situation and vocabulary instead of focusing on the mathematics and reasoning required to solve optimization problem. Isabel described how students failed to make a visual representation for each optimization problem due to the language barrier. She explained how this prevented her students from translating language as text into mathematical expressions needed to solve the problem.

Isabel was not the only participant who felt this way. The excerpt below refers to the comment above about how the phrasing of the exercises in some activities can cause unexpected language issues. Emily had a similar issue:

> Emily: Last term there was a question on a quiz where every single student got it wrong in my class. It was because they all misinterpreted the problem in the same way. "Graph the distance that this person had travel over time. Mary walked to this store, but on the way she ran into her friend." They all thought that meant she just, I don't know, ran to her friend.

Emily described how she did not expect the phrase “ran into” to be unfamiliar to her international students. Emily acknowledged that she was able to recognize this language issue because every single student got the problem wrong in the same way. She then highlighted how this was not a problem with their understanding, but a problem with the wording of the problem. Other participants also commented on how idioms pose a special challenge for international students who are in the process of learning English. Mary explained how oftentimes the language of idioms did not match their meanings, which made idioms unpredictable for most EAL learners.

Mary, the participant who had more experience teaching international students, explained how she anticipated vocabulary words to become a challenge or distraction during some lessons. The excerpt below represents this idea:

> Mary: Squiggles is kind of strange word so I don’t expect people whose first language isn’t English to know the word squiggle […] Like the thing we say in college algebra class is that the square root function looks like an eyebrow. But I’m not sure if that’s the connection that they would really easily make if I didn’t tell them, “Oh we call it an eyebrow.”

In this case, Mary described a class activity that was designed to help students learn the graphs of functions by using common English words to describe each graph. However, Mary mentioned she was aware how this could present some language difficulties for her international students. She also highlighted how she expected students to be unfamiliar with these words.

All three participants mentioned how conversational English vocabulary served as a distraction from the mathematical focus. The participants also mentioned that there were other unfamiliar words that would have been new even to native English speakers such as sinusoidal, cyclic, secant, radian, tangent, inverse,

logarithmic, and respectively. However, in this case, the participants did not expect international students nor domestic students to be familiar with these words outside of a mathematical setting.

During multiple occasions, the participants expressed their desire to focus on mathematics instead of focusing on teaching common English words. Below are some of the comments from the interviews with Mary and Emily that illustrate their views about their role as mathematics instructors:

> Mary: I can teach them math words, but as far as learning English, my job as a math teacher is not to teach them conversational English. I know that they are taking classes to learn English but as far as math, I can teach them math words and how to talk about math.
>
> Emily: I just care that they're learning and its other people's job to make sure they're speaking English well.

These comments illustrate the participants were at times overwhelmed by the language barrier in the classroom. The participants expressed how their role as mathematics instructors is to develop lessons focused on mathematics concepts and academic language that is specific to mathematics. However, they recognized that English language plays an important role in learning mathematics resulting in international students having a dual task of learning the language and content simultaneously.

4.1.2 Challenges engaging students

One of the major challenges encountered by the participants of this study was engaging students in the classroom. The participants reported having difficulties with lack of attendance, students participating in-class discussions, and group activities as well as one-to-one instructor-to-student conversations. For the most part, the

participants of this study saw this challenge as a consequence of the language barrier. All three participants reported having silent students in the classroom. The participants admitted having unsuccessful attempts to break the silence of some international students. Several times through the term, participants mentioned interactions such as the following:

> Emily: I knew that there would be a few people in the class who might not say a single word to me all term. At all. Even when I asked them a direct question. That was a surprise my first time teaching international students. There were some students that had really strong writing and speaking skills and one or two students who never said a word to me all term. Maybe they just nodded their head and said okay, but never said a sentence.
>
> Isabel: I had a student who was asking me a question. I answered the question and he kind of just stared at me. I wrote some stuff down and he stared at me. Then he said, "I just need time." Okay, you can totally have time.
>
> Mary: I have other students who really struggle with English and I guess it's harder for them to get the question out in English and I noticed that because of when they asked questions or if I call on them to answer a question in class and they have a hard time coming up with the language.

In these comments, the instructors describe how some students are unwilling or unable to communicate orally in English. They indicated having difficulties assessing students learning in the classroom. In the case of Emily, she mentioned unsuccessfully attempting to break the silence by asking students direct questions during multiple instructor-students conversation. To her surprise, students often went through a silent period while other students remained silent all term. Isabel described that she had difficulties establishing a conversation with one of her students, which resulted in the student asking for time to process the information. Similarly, Mary also described occasions where her students went through a silence period or struggle

to phrase their sentences. All three participants believed that student silence and problems with oral communications were a consequence of the language barrier.

In addition, Isabel and Emily expressed they had been struggling to improve class attendance. They explained their experience with low attendance when teaching courses to international students:

> Mary: I've taught courses to international students before, and they were always kind of like that. They would only show up when they had a quiz. Really, all of them. But this term it's been particularly low attendance and I guess we're just not to take that personally. It's hard not to be sad when only four show up. But that's their choice. And there's really nothing I can do other than be encouraging when they do come to class.
>
> Isabel: I think that, like, having that language barrier can result in them being very quiet in class and maybe it can be part of the reason it seems to be a trend that a lot of international students skip class at a higher rate than domestic students. I think that maybe that's because they get less out of it. Like a lot of college students are very much tempted to skip class a lot because they think they don't get anything out of it. Then if you're understanding about 50% of what the instructor is saying because content is hard and like another 25%, you're losing just because English is hard.

In the case of Mary, she mentioned that she was uncertain of the origins of her international students' low attendance. Mary explained low attendance is not a unique issue to this class since it has been an issue in previous international student classes. On the other hand, Isabel explained how low attendance might be the consequence of the language barrier in her class since it is possible that students do not understand instructions given in English. Isabel explained that international students face bigger challenges than domestic students learning when new mathematical content while they are in the process of learning English.

Furthermore, the participants described bigger challenges engaging students in group learning activities during class. The participants explained how students often did not make an effort to communicate with people in their groups. They summarized their experiences below:

> Mary: I also feel like group work is really challenging in an international student class, not only because of the dynamics with language, but also just because they are learning these words for the first time, and I didn't think that they can benefit from more guidance when they are learning the material for the first time and learning that words for the first time.
>
> Isabel: So, I find that students in general, tend to sit and zone out and just let themselves write. But it's definitely more of a struggle in the international student classes than it is with the general class to get them to talk to each other. One thing that I think as a few of a lot of the students are a little bit more shy about speaking just because of their English and they're maybe not as comfortable with each other.

Both Mary and Isabel described their struggles to get students to talk to each other during group learning activities. Mary explained that students needed more guidance during in-class activity specially when introducing the mathematical content for the first time and unfamiliar words. Through the study, Mary expressed that the struggle with engaging students in groups made her consider abandoning group learning activities. Along the same lines, Isabel believed international students were nervous and uncomfortable speaking English with their group members. Both Mary and Isabel acknowledged that the language barrier plays an important role in engaging international students in group learning; however, they also acknowledged that this challenge is present in general classes as well.

In contrast, Emily did not report having challenges engaging students in group learning activities in her current class. She mentioned that there were occasions where

groups of students did not understand the instructions given in class that would have enabled them to start group activities on time. In the past, Emily experienced having unengaged students during in-class group activities when she taught her fist class of international students, which was the pre-requisite course for College Algebra. Emily summarized her experience teaching this course in the following way:

> Emily: There are two kinds of students who are in that class in international student classes; the students who should be in there and the students who took calculus in high school, but their English was so bad back in the beginning of the summer when they took the placement exam that they placed in the lowest level math class because they didn't understand the questions. Wide gap of interest in that class. The people who knew absolutely everything were not very engaged. They were bored all the time, finished the whole thing in five minutes and then pulled out their phones and waited for 15 minutes for the rest of the class to get there.

Emily expressed that the difference in English proficiency levels among her students was the biggest challenges when attempting to engage them in group work activities. Emily mentioned she attempted to encourage some students to retake the placement exam since she believed that they needed to be enrolled in higher level mathematics classes, but most opted to continue in her class. As explained by Emily, the group of students did participate in group learning and isolated themselves in the back on the classroom. Emily mentioned that she struggled to engage students during the whole term and did not find a strategy to overcome this challenge.

Similarly, Mary mentioned students' range in English proficiency was a significant challenge during in class activities. Mary explained her uncertainty on how to overcome this challenge below:

> Mary: I think my biggest challenge is their range in English proficiency. That's a pretty big challenge. Yeah, I'm not sure what the best way to address that issue is. Like should, is this, is having a mix of students who are really high in English and students who are pretty low in English, is that the best way to do the class or should everybody who has low English be among one class and people who have high English be in another class.

Mary explained her awareness of the range in English proficiency in her classroom, but also admitted that she was uncertain on how to encourage group collaboration. Mary considered how students are placed in mathematics classrooms. She wondered whether students should be enrolled in mathematics courses based on their mathematics placement exam or if their level of English proficiency should be considered as well.

4.1.3 Challenges creating inclusiveness

Throughout the interview sessions, the participants repeatedly made comments about the challenges they faced when creating inclusiveness for all students in the classroom. The participants mentioned having difficulties with students wanting to only work with students that share their same nationality or native language. This excluded other students who did not share the same nationality or native language as the majority of the students in the class. All three participants described how international students often separate themselves by nationalities within the classroom. The participants mentioned the majority of their international students were from China. Emily explained how students from China formed "a big cohesive group that speaks their own language and never really get forced to try to integrate with the other members of the class." Emily and Mary explained how students grouped themselves in the classroom:

Emily: The two Indonesia students sat next to each other by accident on the first day of class. So, then the rest, and then yeah. The one Latin American student whose native language is Spanish, but he had no choice. He had to pair up with other Chinese students and then the other Chinese students grouped up with each other.

Mary: I think it's partially the demographics of the class. I have, I think 8 out of 12 of them are Chinese students and then I have a couple who are Korean students and then one who's Brazilian. And, so, they kind of section off into their nationalities, because that's who they're most comfortable with and that's fine.

In this excerpt, Emily explained how the only Latin American student felt isolated since there were no other students with the same nationality as him. The phrase used by Emily, "he had no choice," emphasized how she was certain that the Latin American student did not want to pair up with other Chinese students. Likewise, Mary described how her international students sectioned off into their nationalities excluding other students from this particular groups. Through the study, Mary mentioned she had no objection to having students group themselves by nationalities. Mary explained how she was aware of how students do not like to "mix" with other students and how "maybe a certain student doesn't like to work with the Chinese students and that's okay."

On the other hand, Isabel and Emily explained how they often attempt to create inclusiveness in their classroom of international students. Isabel explained how she tried to discourage students from speaking their native language in order to prevent this from excluding students with different native languages. The comments below illustrate this idea:

> Isabel: But I try not to discourage it unless there's a good reason, in terms of like groups functioning or students feeling, you know, alienated because they're not part of that larger group in the class. So, I might give the excuse, which is also a true thing of, if I can't understand what they're saying, then I can't help.
>
> Emily: So those four worked together and they had really strong English skills. So, they were grumpy when they got put it in the group where students did not have strong English skills because suddenly something that was easy for them, namely communicating with their group, was now hard. The Chinese students were grumpy when I tried to pair them with students from another country because they were communicating in an easier way with their colleagues by being able to speak their own language.

Isabel mentioned that this did not stop students from creating groups based on their nationality and that, oftentimes, students used their native language in the classroom. Isabel described how some students would often speak a language that the whole group did not understand which implied they were not working as an inclusive group. Similarly, Emily explained in previous classes, she unsuccessfully tried to overcome this challenge by assigning groups composed of diverse students. Emily described how students were unhappy and frustrated when they were assigned to work with students from different nationalities. She explained how Chinese students were unhappy since they were no longer able to speak their native language with their group members.

Despite the challenges encountered when teaching international students, the participants demonstrated positive attitudes towards their students. Below are some excerpts from the participants that show this idea:

> Emily: They're fun when they come out of their shell because I think in general, you know, new country, new language, they can start out pretty nervous. But once they warm up, it is like a relief to

be in a scenario where they're comfortable and that can be really fun.

Isabel: Like I'm just always surprised, which is really fun and also points out to me places where I can be clear, or like what I do that I expect people to understand.

Mary: So, I hope they remember that I care about them as not only not students, but as people because I know how challenging it must be for them to be in this place without any of their friends or family.

These comments illustrate how the participants enjoyed teaching international students. The participants' positive attitudes towards international students could be considered to influence some of their teaching adjustments when teaching these courses. In the next sections of this chapter, I will discuss the teaching adjustments made by the participants to support student learning and to overcome the language barrier.

4.2 Adjustments to teaching practices

During the first interview, participants were asked if they made changes to their teaching practices when teaching a mathematics course to international students. All three participants believed they did not make drastic changes to their teaching practices at the beginning of the term. Initially, Isabel and Mary mentioned they did not change their teaching methods, but that they changed the way they interacted with their students. On the other hand, Emily pointed out some specific pre-assignment adjustments made to support students with the language. As the term went by, the participants made adjustments to their teaching practices to support international students in the classroom.

When the participants were asked if they received any special training before teaching a course to international students, all three participants responded they did

not complete any special training. Below is one of the excerpts from the interview with Emily where she explains most of her training with international student comes from:

> Emily: I don't know about strategies so much. The more I teach, the more I have a better idea for what's not going to be understood or what words are commonly misunderstood or phrases.

In this excerpt, Emily stated she did not believe she needed to have special knowledge of any strategy to support international students with language issues. According to Emily, the experiences interacting with students caused her to make the teaching adjustments necessary to overcome the challenges presented in the classroom. Similarly, Isabel and Mary recognized that they were learning how to adjust their teaching methods while interacting with their international students during the term of this study.

At the beginning of the 10-week term, the participants were asked to describe their teaching practices when teaching a course to international students. Emily and Mary described their teaching practices as primarily active learning-based. As described by these instructors, active learning refers to a range of teaching strategies to engage students to actively engage in their learning process through activities and group discussions. The participants mentioned that the materials used in class required students to manipulate and create new content through each mathematical lesson. Emily and Mary emphasized that they did not teach through traditional lectures; rather, they often made use of a short class discussions to address students at the beginning of class. On the other hand, Isabel reported using traditional lectures although she desired to incorporate more active learning. Isabel explained she was

learning to present the material for the first time since she had not taught differential calculus before. Isabel clarified that her teaching approach was based on this being her first time teaching differential calculus, and less on teaching international students.

As the term went by, the participants reported making specific adjustments to their teaching practices according to the challenges presented in the classroom. In some cases, they implemented additional strategies to support their students, while in other cases, they admitted having to abandon teaching practices utilized at the beginning of the 10-week term. In this section, I will discuss specific adjustments made by the participants to support international students mathematical learning in the classroom. The teaching adjustments reported by the participants included: adjustment to verbal and written instructions, implementation of strategies for vocabulary development, incorporation of methods to support mathematical talk in the classroom, and accommodation when implementing the English-Only policy.

4.2.1 Adjustments to verbal and written instructions

The participants reported attending a course coordination meeting each week where they designed the curriculum and materials for the course. They explained that the purpose of this meeting was to ensure instructors were providing a similar experience to all students enrolled in different sections of the course. Participants reported having some limitations of the adjustments they made to class materials such as class activities, quizzes, and exams. The initial teaching adjustments made by the participants involved making modifications to their language and writing in order to

support students who entered the classroom with limited experience with the English language.

The most commonly reported adaptations were participants' efforts to adjust speech in different ways. For example, Mary described using a steady but slower rate of speech to allow students to process the information. The excerpt below illustrates how Mary adjusted her speech when teaching this course to international students:

> Mary: I think if I talk a little bit slower and try to annunciate words, it helps them have an easier time processing the words are being said, and if there's a new word it gives them a little more time to understand what the word means […] I do notice that I go slower in my international student class than my regular class. Like if I ended five minutes early in my regular class, I'll go all the way up to time in my international student class because I go slower. That one was probably in particularly pretty slow.

Mary believed that talking slower enhanced student comprehension and gave more time for students to think in both languages. Based on her own experiences learning a second language, Mary described how often there is "a lot of translating back and forth in your head" during the early stage of learning a language. In order to support these students, Mary mentioned making efforts to use her words carefully and to enunciate words that may be new to some students.

In addition, Mary as well as Isabel reported avoiding colloquial expressions or words unnecessary in academic writing which lack specificity of meaning. Mary and Isabel acknowledged the importance of delivering mathematics to students as precisely and unambiguously as possible. The excerpt below illustrates Isabel's thoughts about using colloquial expressions when teaching international students:

> Isabel: I make an effort to be a little bit less colloquial. And like with the differential calculus students, I think a lot of what students tend to struggle or what I think sometimes they need is like some help with bridging the gap between this is the formal definition of this mathematical object, and this is the understanding that you already have […] I can't use this colloquialism or I can't use this detail from my past that 40% of, well not 40%, but like 60% to 80% of like a general class that I teach will definitely understand. Like I'm not sure if this works here.

In this regard, Isabel explained how colloquial expressions or words might not present a challenge to domestic students. However, Isabel recognized that most of her international students might have difficulties understanding colloquial expressions since these types of expressions can often lack meaning. Mary and Isabel both reported trying to reduce the language demands for international students to avoid language issues and maintain students' focus on the mathematics.

Moreover, all three participants reported making constant efforts to anticipate possible language issues in order to adjust their language. Participants explained how anticipating possible language issues helped them prepare to describe mathematical language in multiple ways. For example, Emily explained how the word *respectively* is commonly unfamiliar to most international students. The excerpt below illustrates the explanation Emily gave to her students:

> Emily: Because it had something that was like for angles a and b in triangle one, they correspond to angles C and D in triangle 2, respectively. It is something that comes up in math a lot but it's just like an English phrasing way that talk about how things happen in order and then you, you know, continue that order.

In this excerpt, Emily makes an effort to focus on the use of the word *respectively*. Emily did not use the formal definition of the word *respectively*, instead, she made emphasis on how the word is used in a mathematical setting. Throughout the study,

the participates mentioned how, oftentimes, they were required to articulate their language to usage of common English words as technical mathematical terms.

Furthermore, participants reported making adjustments to their writing when presenting mathematics to international students. The participants mentioned how they made efforts to provide instructions in writing instead of simply giving instructions verbally. The comment below is an excellent illustration of how all three participants incorporated written representations of the verbal explanations given in class:

> Isabel: So one thing that I tried to do more a little bit is trying to write down more of what I say [...] So, I try to have all of the important points that I need them to understand written down, including a little bit more of like the explanation that I would normally just say. I try to write that down a little bit more just so that if they're purely writing and not listening, then they'll have that trickle back to and reread.
>
> Emily: So, I always try to put in writing what's happening so that they just don't have to listen to it or listen to me. Oh, if we're taking the due date on something, I'll send an email to the whole class. So that cuts down on the amount of like missing assignments because they didn't understand something.

In this comment, Isabel explains how she gave verbal instructions with additional written comments to support students who are having difficulty processing auditory information. Similarly, Emily explained that sending emails about assignment deadlines changes in order to provide a written representation hoping to reduce the amount of missing assignments. In addition, Emily described how the course materials were complicated to understand because of the complexity of technical mathematical terms used in most of the activity instructions. Emily believed that the authors of the materials sacrificed understandability to be mathematically precise,

which created difficulties for all students, including the domestic students in other sections. Emily mentioned how she made constant efforts to provide written rephrased questions from the workbook in order to help students continue actively learning in small groups.

Likewise, the participants made efforts to adjust the language used in written instructions on class activities, especially on exams. The participants mentioned how exams were created with the help of all instructors teaching the same course in this institution. However, the participants explain how they made efforts to pay attention to the language used on the exam hoping to identify possible language issues for their international students. The excerpt below describes this idea:

> Mary: I prefer the language in the textbook to the language online. And we try you know like right when we write quizzes and activities and stuff, we try to think about the language a lot and to be clear and concise with the words that we choose.
>
> Emily: So, like on homework and quizzes and exams, I tried to work it in a way that straightforward on what we want to get at because I want to test them on what they know on the concepts. I don't want to test them on like can they analyze this sentence and figure out what they mean when it took me a couple of minutes to even say "What do they mean? What are they asking for?"

Mary explained how she made sure to use the same language from the textbook on exams. Similarly, Isabel also mentioned that using new vocabulary on exams can be a disadvantage for international students since oftentimes students use their cellphones to translate words during class activities. Both Mary and Isabel acknowledged the importance of creating exams using the same language previously used in-class activities and the textbook. Along the same lines, Emily mentioned the importance of ensuring that exams are written to assess students' mathematical knowledge instead

of students' English proficiency levels. For this reason, Emily explained that language choices on exams should be friendly to non-English native students. In addition, Emily mentioned how she advocated for lessening the cognitive load required for understanding problems on exams as well as including pictures where the wording was unclear.

4.2.2 Strategies for vocabulary development

To help students with unfamiliar vocabulary, Emily mentioned using a method involving three assignments: a pre-assignment, an in-class assignment, and a post-assignment. Emily explained that this approach was adopted to foster student preparedness for an activity-based class. When Emily was asked if she had made any changes to her teaching practices when teaching international student, she responded:

> Emily: Each of those classes has a pre-assignment, the assignment in class and a post-assignment…One thing I asked in the international student session is also: What words do they not understand even after having looked them up? There'll be a word that just is a word that means something in English and they know the word for it, but it has its own specific math meaning that they didn't understand what the math meaning was.

In the quote above, Emily mentioned making specific changes to the pre-assignment requirements. Emily explained how she asked her students to submit key phrases or new vocabulary words found when completing the reading assignment as part of the pre-assignments. The pre-assignment directed students to engage with specific exercises and reading materials as well as unfamiliar vocabulary. Emily explained how she kept a list of all the words submitted by her students and reported spending the first few minutes of class clarifying the vocabulary words.

In addition, Emily described focusing on "hammering on the language" when

presenting new content material in class. Likewise, Isabel mentioned identifying key phrases or new vocabulary to avoid language difficulties during lessons. The following excerpts demonstrate how Emily and Isabel thought about how vocabulary use in mathematics can have multiple meanings:

> Emily: I try to be aware of things that I think are going to be unusual or have a very specific mathematical meaning that's going to confuse them if they are trying to like use like a translator app or something to figure out what this word means. So, I try to be aware of that and I try to emphasize those meetings when I can at the beginning of class.
>
> Isabel: But when you ask them, "What are the dimensions of this object?" It's like what is dimension? Because they know one English meaning but not another. So that's one place that they may gain some depth of understanding of an English word because it kind of made me think a lot more about the word dimensions. Like yes, three dimensions, but then why is dimension a measurement?

Emily explained how she identified words that have specific meanings in a mathematical context but have entirely different meanings in other contexts. For example, Emily mentioned spending class time explaining the definition of inverse in the English language as well as how the word inverse is used in mathematics context. In the excerpt above, Isabel noted that words that have multiple meanings in English such as dimension can be difficult for international students. Isabel also mentioned how this can create major difficulties in some occasions since "there's not only one word that might be different, but there's a few words." The awareness posed by both Emily and Isabel of possible language difficulties for international students influenced them to assign in-class time to discuss words with multiple meanings.

In contrast, Mary did not report to spending time focusing on definitions or talking about new vocabulary words in class. On some occasions, Mary mentioned

explaining the meaning of words if requested by her students. Mary explained how she made use of hand gestures to clarify the meaning of words during class. In the following exchange, Mary described how she uses hand gestures during a lesson on function transformations:

> Mary: Thinking about transformations… I do try to emphasize the words of the translations. So, for example, a vertical stretch. I think the word stretch is kind of a funny word and so I kind of do… I do have a hand motion like this [hands stretching vertically]. Or it's stretching like this [hands stretching horizontally], oh it's a vertical stretch.
>
> I think like shifting to the left and right I don't think there's a huge language barrier there. I think reflecting across the X or Y axis can be a little bit of a challenge and I'll do this [hand flip horizontally] for reflecting across the x-axis and I do this [hand flip vertically] for flipping across the y-axis.

In this exchange, Mary explained that she was unsure whether her international students made the connection between the definitions of words related to transformations and the use of these words in mathematics. Instead of defining the function transformation words, Mary used hand gestures to demonstrate the vocabulary in front of her international students. On other occasions, Mary mentioned that she would use hand gestures to describe the shape of different function graphs.

4.2.3 Supporting students' mathematical talk

There were a number of strategies employed by the participants in order to support students with talking about mathematics. The participants acknowledged the importance of learning how to communicate mathematics, as well as the difficulties international students might experience when engaging in mathematical discussions. The participants utilized a variety of strategies and resources to help students communicate mathematics in the classroom. Among these strategies, they used

similar strategies to uncover the mathematics in students' comments and promote student participation in class.

Mary and Isabel described how they moved past their students' unclear utterances and attempted to uncover the mathematical content in what their students say. They indicated how they revised student statements to support students' mathematical talk and oftentimes prompted the students for clarification. When asked how they managed to understand students' contributions when students are having difficulties with the language, this is what they said:

> Mary: I expect them to like ask the question in the correct language instead of them just being like "ASYMPTOTE?" I would say, "what about the asymptote?" … If I hear the word intercept, then I will say, "So I think you're asking about an intercept and sorry, what are you asking about the intercept." It can be challenging you know because I don't want them to be embarrassed.
>
> Isabel: I will repeat back to them what I understand from what they said and say, "Is that what you meant?" And sometimes they'll say, yes and sometimes they'll say no. And, so, I think I just tried to have a dialogue.

In this excerpt, Mary explained how she expected students to use correct language while still acknowledging some students need support with speaking in front of the class. Mary focused on uncovering the mathematics in what students said instead of focusing on correcting their use of English. As explained above, Mary prompted students to complete their sentences by encouraging explanation. Isabel explained how she attempts to have a dialogue with her students in order to uncover the mathematics during class discussions when she is uncertain about what students are saying.

On the other hand, Emily mentioned that she avoids having class discussions; instead, she chooses to answer individual questions while students work in groups. Emily mentioned how some "students are still really getting a hang of the language," and acknowledged that some students don't like to talk in front of the classroom. In the following excerpt, Emily explained how she attempted to understanding students' comments during one of her lessons:

> Emily: I'm mean it's awkward every time and I mean it happens. Definitely. I mean you witness one last time. Yeah, I just, I try to muddle through it, you know, "Do you mean this? Do you mean that? I'm not sure. Is it something like this?" I mean, I guess eventually, I might say, "Okay, well, why don't you keep me that idea in mind we're going to move on. But then I'll come and talk to you and I'll figure it out."

In the description above, Emily was referring to an occasion where she prompted a student to ask a question in English after she noticed them having a side discussion with another student. Emily mentioned how the students "just sat there and sat there and sat there" in silence, seeming afraid to ask the question in front of the class. As a consequence, Emily explained how she makes efforts to support the communication of mathematics within each individual group instead of having class discussions.

Furthermore, Emily explained how she supports communication within individual groups:

> Emily: Sometimes with international students when I don't think their language skills are strong enough for them to narrate**,** I will to kind of give them an idea of how to talk about their reasoning. With American students, I would probably always make them tell me how they got up there. But yes, I guess I did some narrating.

Emily mentioned that she used third-person narration to describe the thinking process of her students when talking in small groups. Emily mentioned she directs domestic

and international students to narrate their reasoning on a problem, while oftentimes, she narrates international students thinking process to demonstrate how to talk about their reasoning. Emily made use of this strategy with the purpose of giving students an example of how they can explain their thinking process when working in small groups or asking questions to their instructors. Emily's class was focused on active learning and she expected all students to try to communicate within their groups.

All participants mentioned that there are students in their classrooms who are afraid or unwilling to talk in front of the classroom or small groups. Emily explained that she was uncertain about how to support students who are currently going through a period during which they seemed to want to stay silent. Mary and Isabel described similar experiences and reported using passive communication to assess students' knowledge in the classroom. In the following excerpts, Mary and Isabel describe some of these interactions with their students:

Isabel: So, I have a few students who I think understand almost nothing of what I'm saying, but they are silently participating. Like I turned around and I smile at them and they smile back and they nod, and then I think, "Oh, no. I think you're lost." And so, like, there's that form of like passive participation, which I really do appreciate that they're like trying to be engaged. And like if that's what they can do, that's great. But for a lot of students, I think that like having that language barrier can result in them being very quiet in class

Mary: But I'm not sure if that's the connection that they would really easily make if I didn't tell them "Oh we call it an eyebrow." So by then doing it in the air it kind of gives me like a quick sense of whether or not they know the shape of the function. So I think that that the gestures like that are helpful in terms of me assessing their knowledge without using words.

Isabel described how she pays attention to students' body language to allow them to communicate without talking. Isabel recognized that some students do not have a high English language proficiency, but she appreciated them making the effort to

participate. Similarly, Mary mentioned how she pays attention to students' hand gestures to assess their mathematical content understanding and knowledge. For example, she described how she first paid attention to the hand gestures students used to describe the graph of functions and then made references to the words commonly used to describe each graph function.

Moreover, all instructors explained how they offered peer collaboration opportunities in the classroom can serve as a resource when learning mathematics in English as an additional language. All participants reported proving opportunities for students to participate by incorporating pair and group work. Through the study, the participants mentioned how students offer bilingual support to each other in the cases where students share the same native language. For example, Mary explained her thoughts about students using their native language in the classroom.

> Mary: I think… translation progress is fine because they're trying to learn the English word and I think that's a good tool, it's like having a dictionary for homework problems or questions about the homework that they are talking to each other. Because they, you know, know the language and they know the translations and they can help each other with the translation more than I can obviously.

Mary mentioned that incorporating group learning in her lessons helped students to help each other clarify or translate new vocabulary within their groups.

Similarly, Emily mentioned doing small group discussions instead of whole class discussions. In the following excerpt, Emily explains why she made this choice:

> Emily: A lot of students have only been, especially in the fall term, but even now students are still really getting a hang of the language. And they don't like talking in front of other people. So normally I don't do whole class discussions. I have them work in groups like I did at the very end. Then I go around or answer questions and talk to them individually as much as I can.

Emily explained how students often feel more comfortable sharing their ideas in a small group environment. On previous occasions, Emily shared some of the moments where students refused to talk in front of the class and how uncontrolled this was for both the student and her. Emily also mentioned that separating students into small groups allowed them to answer individual questions and gave more time for students to talk with their peers.

In the case of Isabel, who reported using the traditional lecture method, she explained how she incorporated some active learning strategies as the term went on. Isabel mentioned having students work in groups on assigned problems and then had them present the solutions in front of the class. Isabel explained how she implemented group work and class presentations:

> Isabel: I always had them in pairs, so that if one person was uncomfortable saying one part and the other person could take over. Like they had someone to rely on. Sometimes that turned into the one who speaks English fluently does all the talking, and the one who does not, does not talk.

Isabel explained that the purpose of having students do presentations in front of the classroom was to give students the opportunity to practice speaking mathematics. In order to support beginning English learners, Isabel had students do presentations in pairs so they could provide each other mutual support in case of any language issues. Even though most of the time the student with better English speaking proficiency did most of the talking, both students were expected to contribute to the presentation. Isabel continued implementing class presentations since doing so motivated students to talk more in their small groups. Similarly, Mary also reported making use of in-

class presentations, and mentioned students did not have any difficulties explaining their reasoning in front of the class.

In contrast, Emily reported abandoning using in-class student presentations when teaching this particular class of international students. She mentioned how, in the past, she used in-class student presentations to motivate students to practice talking about mathematics in a professional setting. The excerpt below illustrates the reason Emily abandoned in-class student presentations:

> Emily: If their English skills were not great, they would just stand there and point. It was kind of painful and it took forever. It wasn't helping the rest of the class. It was actually kind of making the rest of us disengage because they would see one of their fellow students go up there with the right thing on the board. They checked, okay that is what I have […] It seen like students really felt put on the spot. Really didn't like it and they weren't doing a great job explaining and so the other students weren't learning from it.

Emily described the language barrier interrupted the purpose of the implementation of in-class student presentations. Emily illustrated a "painful" moment when students stand in front of the class unable to formulate their sentences in English when explaining their solutions to their peers. Emily mentioned she believed that students were not learning from doing class presentations which influenced her decision to abandon this teaching practice.

4.2.4 Implementation of the English-Only policy

At the entrance of each classroom at the international student building, there is an "English Only" sign explaining that all students are expected to speak English inside the classroom. The English-Only policy established by the international student program caused an internal dilemma for the participants on whether or not to

implement such a policy in the classroom. On one hand, the participants recognized that not implementing this policy in their teaching practices allowed students to use their native language in the classroom, which served as a resource for mathematical learning. On the other hand, the participants acknowledged that not implementing the English-Only policy was contradicting the international student program rules and could cause students to feel isolated since not all students shared the same native language. Emily and Isabel stated they did not implement the English-Only policy in the classroom while Mary did implement the policy.

The participants explained how students can use their native language as a resource for learning mathematics in the classroom. The following excerpt from one of the interviews with Mary summarizes how the participants thought of implementing the English Only policy:

> Mary: In theory, it's a good idea because the international student program is trying to help the students develop their English as much as possible. So, I think it's a good idea in theory, but in practice... If you're learning a new math word for the first time and you have a question about it, like if it's necessary to ask your Chinese friend, "Katie, like what is this in Chinese?" I don't think that's a bad thing. So I don't know**.** I think it's kind of a double-edged sword.

As stated by Mary, the participants understood the mission of the international student program and the reasons why they expect students to speak in English in the classroom. However, participants explained how grasping the mathematical concepts might sometimes require students to communicate in their native language, leaving little time to focus on mastering the English language. The participants explained that their teaching choices revolved around mathematical learning as well as learning of academic English language necessary for mathematics. In particular, Emily and Isabel

explained that the only time they enforced the English-Only policy was when they felt that a student was being excluded from a conversation in the cases where not all the students in a class spoke the same native language.

The participants questioned whether implementing English Only instruction could have major effects on their students' learning. The comments below represent the participants' mixed feelings about the English only policy:

> Isabel: I don't want my students to feel handcuffed by that because they are still being held to the same standards as domestic students, so they need to know the material just as well and understand it just as well. So, I want them to have the intention of English first but then if they need to use that other language that they know way better in order to understand the material, then I don't might it.
>
> Emily: But I just don't have the heart to stop, like, good learning from happening in order to get them to speak English with each other.

In these comments, the participants portrayed their mixed feelings towards the implementation of the English-Only policy. Isabel used the word "handcuffed" to describe how not allowing international students to use their native language as a resource can result in a disadvantage when learning mathematical concepts. Similarly, Emily mentioned that she does not want to stop students from speaking their native language since it can have an impact on their mathematical learning. Through the study, Emily emphasized that she wanted her students to primarily focus on learning mathematics in the classroom instead of focusing on the development of the English language. Emily mentioned that if students felt like it was "more efficient to ask a question in your own language," then students should be allowed to use their native language to clarify their understanding with their peers.

Through the study, Mary mentioned multiple times when she had to remind students to speak in English; however, she also reported having mixed feelings about the implementation of such a policy. In the following comment, Mary explained how she felt about implementing the English-Only policy:

> Mary: It's also hard to implement it in a nice way. Right. I don't feel comfortable saying "Speak English." It seems like kind of harsh to me. And also, like I am taking away part of their identity or something.

Mary explained feeling uncomfortable asking students to speak in English during group learning activities. She believed language is intrinsically related to culture and she worried about how the implementation of the English-Only policy could result in students' loss of culture and identity in the classroom. On certain occasions, Mary mentioned allowing students to use their native language to translate or clarify the meaning of new vocabulary words. Despised her internal feelings, Mary decided to implement the English-Only policy during the whole quarter with the purpose of having students practice speaking English in the classroom.

4.3 Differences in classroom culture

Through the study, the participants shared their experiences interacting with students who were used to a different kind of classroom cultures. The participants demonstrated that they are aware of different worldviews in the classroom, and worked towards understanding how students' understanding of classroom culture and classroom norms can influence students' behavior in the participants' classrooms. On different occasions, participants noted that factors such as class expectations and academic culture in America and the interpersonal space amongst students were

issues that arose in their classrooms. The excerpt below illustrates Isabel's perspective:

> Isabel: I think the students sometimes they're in a place where they don't know most of the rules for like interacting with each other or interacting with a teacher…They're wondering like "Is this social norm? Should I be doing this?" And there's a lot more questioning just everyday actions. So, I think giving a little bit more guidance in terms of, like, I want you to do this now or work with this person.

Furthermore, the participants explained that some of the challenges experienced in the classroom could be a consequence of students being in the early stages of adjustment to the culture of American classrooms. Throughout some of the interviews, Mary and Isabel expressed having difficulties engaging students in group learning. The participants made efforts to analyze the possible factors influencing students' engagement during group learning activities:

> Mary: So just saying, you know, encouraging them to work in groups and maybe modeling what that looks like. Maybe they don't know what it's supposed to look like to work in groups. So, showing them what that's supposed to be like, yeah.
>
> Isabel: I think that maybe some of my students are…you know, high school, elementary school, and middle school, they train us, right? They train us to behave a certain way in a classroom. So, I think that there may be trained to behave in a certain way and getting them to break out of that a little bit and like react to how I want the class to go can be a challenge.

In the comments above, Isabel and Mary explained the possible connections between students' behavior in the classroom and students' previous educational experiences. Isabel described how students' behavior in the classroom can be a result of their previous experience during their early years of education in their country. On another occasion, Isabel mentioned how it was possible that "students think they should just be sitting there and quietly taking notes or watching someone lecture." On both

occasions, the participants reflected on the differences between American classroom culture and the classroom culture in other countries.

Some participants provided detailed examples of occasions where students voiced their opinions about how mathematics is taught in America. The participants explained how they made efforts to provide an explanation to help students understand the purpose of some of their teaching practices. The excerpts below illustrate some of these occasions:

> Mary: Like today he mentioned that in Brazil, they don't ask questions like, "What does this ordered pair mean in the context of the problem?" and we do a lot of that in college algebra class […] And I said, oh really, "Yeah, I think, you know, these types of questions can be really helpful because it helps us tie the math to real-life situations," and he was like "oh, okay."
>
> Emily: So, I will often say like, "In American high schools, you will see things written this way and not that way. And here is why." […] And yeah, I think it just gives them some perspective on what it's like and why things are taught a certain way here and why they're seeing it in a certain way, as opposed to how they saw that in the past.

Both Mary and Emily welcomed students' comments about their connections between their experiences with two different learning systems. Mary and Emily indicated that they made efforts to help students understand the learning system in American mathematics classrooms.

Additionally, the participants reported making efforts to help students adapt to a new classroom culture by making class expectations clear for all students. Participants indicated that they made attempts to eliminate confusion about expectations of student behavior in the classroom:

Emily: I like really to put a hard sell on active learning. This is what you do to learn. This is how your brain works. Like I like lecturing. I would do that if I thought that you do learn better because I enjoy it […] Basically I established classroom norms by just never letting them see anything else.

Isabel: I think the things that students that I've had appreciated that I've done have been like just having class expectations be very clear. Like, I think that enough things are surprising and like maybe feel shaky to them a lot of the time. And, so, having like the class structure feel solid can be a little bit of like a relive.

Emily indicated how she fostered class expectations about active learning starting on the first day of class. In class, Emily constantly promoted the importance of active learning with the purpose of motivating students to take personal responsibility to adjust their learning and behavior in the classroom. Similarly, Isabel acknowledged how clarifying class expectations can support students who are uncertain about what is expected from them.

Finally, the participants elaborated on how they made efforts to understand what students expected from them as instructors. At the beginning of the study, participants admitted being uncertain about what students expect from them as an instructor. Mary and Isabel provided detailed examples of where they struggled to understand students' expectations. The excerpt below illustrates some of these occasions:

Mary: So like for example, yesterday I had a student email me at 3:45 in the afternoon asking if he could meet with me… And, so, he emailed me again this afternoon, saying "I was late. Can we meet again today?" but I didn't get the email until 4 o'clock. Because I've never had the experience of having a student whose first language is English requesting a meeting the same day, especially if you email me that late. I just think that's maybe that's expected of the university professors there in China. Like if you want to meet you can meet today, you know, no matter what time you email me.

> Isabel: I have one student right now who is very active in emailing me every time he needs something. But also, the emails that I get from his tone, I feel like they're rude […] Like if he says something like, "I need you to do this." I'm like, wait, don't just tell them "no" because you don't like the way they asked. Just understand like that the tone is not everything.

In these excerpts, Mary and Isabel indicated how they considered the possibility of a misunderstanding about the expectations international students have from instructors. Mary indicated that she made efforts to understand the connections between students' request and their previous experiences with other instructors from their country. Isabel also mentioned having difficulties understanding the demands of one of her students. Isabel indicated making efforts to adjust to the way students request accommodations by trying to ignore the informality and tone of the written emails she receives from her students.

Chapter 5: Conclusion

From the themes identified in Chapter 4, I discuss some preliminary conclusions regarding the experiences of instructors when they were assigned to teach mathematics for international students. In this chapter, I discuss the findings, as well as the implications for teaching, limitations of the study, and implications for future studies.

5.1 Discussion of findings

As stated in Chapter 2, my study aimed to answer two questions:

1. What are the experiences of mathematics instructors when assigned to teach a course for international students?
2. How do mathematics instructors perceive and work with a language barrier in mathematics classes?

After analyzing the data collected through this study, I believe my study provides some answers to these questions and deepens our understanding of how mathematics instructors experience teaching international students. The findings from my study illustrate how instructors experience several challenges when teaching mathematics to international students at the post-secondary education level. In addition, I have found that the instructors' thoughtfulness of the presence of international students in the classroom allowed instructors to make necessary teaching adjustments to support international students. Lastly, the findings illustrated how instructors consider possible differences in class cultures allowing them to understand international students' behavior in the classroom.

5.1.1 Discussion of the challenges faced by instructors

The majority of research studies with international students in post-secondary mathematic courses have identified the English language as one of the most influential factors in the mathematics performance of international students (Barton & Neville-Barton, 2003; Gerber et al., 2005; Mestre et al., 1982). Similarly, the participants of this study identified the English language as one of the major challenges facing international students in their classrooms. The participants explained how unfamiliar vocabulary served as an obstacle for students' ability to focus on the mathematics.

Another major challenge experienced by the participants was engaging students in class discussion and group learning. While there are many who recommend implementing group learning activities in international student classrooms, the participants of this study experienced a big challenge engaging students in group work. Mary and Isabel struggled with low class attendance as well as a lack of students' participation in small group discussions. In the case of Emily, she mentioned unsuccessfully attempting to establish conversations with her students during class activities as well as class discussions.

Surprisingly, a challenge reported by the participants was creating inclusiveness – a space where all of the students felt included in the group learning activities. The participants explained how some students who did not share the same nationality as other students in the class were excluded as other students often grouped themselves into their nationalities and spoke their native language within these groups. As a result, the participants found themselves in a dilemma about whether students should be allowed to speak their native language in the classroom.

One view of bilingual mathematics learners is that students' native language serves a primary resource in describing patterns and making generalizations in the process of learning mathematics (Moschkovich, 2007). Similarly, the participants of this study recognized the importance of allowing international students to use their native language in the classroom to serve as resources for mathematical understanding, but they also experienced this as an obstacle to group learning for all of their students.

5.1.2 Discussion of adjustments to teaching practices

Minimal research has been conducted on instructors' adjustments of teaching practices when teaching international students at post-secondary institutions. In previous studies, it has been noted that faculty expressed reservations adapting their teaching practices for linguistically diverse students (Haan et al., 2017; Sawir, 2011). In particular, some faculty explicitly stated they should not be expected to become "EAL experts" (Haan et al., 2017). Similarly, Emily and Mary stated their role as mathematics instructors was not to teach common English. As Haan et al. (2017) point out, part of teaching a discipline such as mathematics requires the focus of helping students learn how to write, read, and speak like a member of the academic community. Thus, instructors are expected, to some extent, to become language instructors in their discipline.

In this study, all three participants indicated a great awareness of the presence of international students and made specific adjustments to their teaching. The participants made adjustments to verbal and written instructions by talking slower, avoiding the use of colloquial expressions, and by providing explanations of unfamiliar vocabulary. In addition, the participants made efforts to provide both

verbal and written instructions to support students who had difficulties processing auditory information. The participants placed value on using specific strategies to define mathematical words as well as unfamiliar English common words.

Furthermore, the participants focused on supporting students' mathematical talk by utilizing a variety of strategies and resources. Mary and Isabel made efforts to revise and rephrase students' statements in the cases where students had difficulties phrasing their statements during class discussions. With similar purposes, Emily demonstrated how to talk about mathematical reasoning by narrating international students' thinking processes during small group discussions. In addition, Isabel and Mary appreciated the efforts students made to participate in class and paid attention to students' passive participation through the use of hand gestures and facial expressions.

In other cases, the participants admitted not having a strategy to overcome some of the challenges presented in class. As one example, Emily was unsuccessful in getting students to break their silence in class during the whole term. As other examples, Mary and Isabel mentioned they did not have a strategy to engage students in group learning activities. In addition, they were uncertain about whether to enforce the "English-Only" policy established by the international student program. The participants considered how the "English-Only" policy served as a motivation for students to practice speaking in English; however, the participants also considered the benefits of allowing students to speak in their native and how this was related to the enhancement of students' mathematical knowledge and understanding.

5.1.3 Discussion of differences in the classroom culture

In other studies, a common theme identified was the negative perceptions university faculty have of international students' academic skills (Gallagher & Haan, 2018; Gallagher et al., 2020; Samuelowicz, 1987). In particular, it was reported that the majority of faculty participants constantly described students as being deficient, vulnerable, and inadequately supported (Gallagher & Haan, 2018). Other studies highlight how making cultural assumptions often determines how we perceive others and how this can affect our social interaction with others (Valdez, 2015).

In contrast, the participants of this study demonstrated thoughtfulness and willingness to understand how differences in classroom culture between other countries influence students' behavior in the classroom. Instead of having negative attitudes towards the lack of students' participation in the classroom, the participants sought to understand the possible factors influencing students' silence in the classroom. The participants considered their students' English speaking confidence, and previous educational background to be the main factors influencing students' lack of participation in class discussions and group activities. In addition, the participants made efforts to offer explanations of the teaching practices used in America that might differ from the teaching practices used in other countries. The participants saw value in making students aware of differences in classroom culture between educational systems and emphasized the importance of clearly establishing classroom expectations at the beginning of the term.

5.2 Teaching implications

The results of this study suggest a sense of urgency to provide better resources to instructors. In the form of training and professional development, guidance can be

provided to instructors to adopt teaching practices that are inclusive for all students and to promote collaboration between all international students in the classroom. The participants of this study expressed that they would benefit from training on how to support international students in the classroom.

If instructors perceive international students as deficient and focus on correcting their vocabulary use, this will serve as an obstacle that prevents them from focus on students' mathematical reasoning. As a result, instructors can be influenced to adjust instruction that does not focus on mathematical content (Moschkovich 2012). As noted by Moschkovich (2012), instructors need to focus on the mathematics by assessing students' mathematical knowledge, regardless of students' proficiency or fluency in communicating their ideas in English. In order to support mathematical discussion in the classroom, instructors can use three instructional strategies: building on students' responses, asking for clarification, and re-phrasing student statements (Moschkovich, 2012). In addition, classroom assessments that include the use of gestures, multiple representations, oral reports, and group learning activities can serve as resources for communicating mathematical ideas and accessing student mathematical knowledge (Garrison & Mora, 1999; Moschkovich, 2012).

Throughout the term, the participants of this study made necessary adjustments to support international students in the classroom. The participants made adjustments to verbal and written instructions, employed strategies for vocabulary development, and implemented strategies to support students' mathematics communication in the classroom. Details about these types of strategies could be included in some form of training for future instructors who are assigned to teach

classes for international students. In addition, training sessions could include details to help instructors understand the purpose of the "English Only" policy and the challenges instructors might face when implementing this policy in the classroom.

Furthermore, it is necessary to recognize that differences in classroom culture and expectations vary from one educational system to another. If instructors fail to notice that students are in the process of adapting to a new cultural classroom environment, there can be differing expectations from students and instructors. With the right guidance, instructors can facilitate the transitions from the students' home country educational system to the American educational system. As recommended by the participants, it is important to clarify class expectations in order to help students recognize the new learning approaches they need to adopt. Actively learning about international students' previous educational backgrounds can enable instructors to understand student behavior in the classroom and create classroom activities that help international students adapt to their new classrooms.

5.3 Limitations

Although a variety of mathematics courses were offered by the international student program at this university on the term this study took place, only six instructors self-selected to participate in this study. The number of participants is a limitation and it is uncertain whether the results apply to a larger and more diverse group of participants. For instance, the instructors of this study were all in their early years of teaching and had few years of experience teaching mathematics courses. It is possible that the experiences of senior instructors differ according to their experiences teaching mathematics courses. One way to change or improve this would be to

conduct the study over several terms, in order to give more opportunities for instructors to self-select to participate in the study. Conducting the study over several terms would also allow different instructors to participant since oftentimes different instructors are assigned to teach the same course.

Another limitation of this study was the lack of diversity in the participants. In this study, all of the participants reported being born in America and all were native English speakers. As there has been much research completed on how faculty members' backgrounds can shape their attitudes and beliefs about international students (Jin & Schneider, 2019; Wang & BrckaLorenz 2018), it would have been interesting to have had voices from faculty with different backgrounds.

Finally, I acknowledge that the development of each of the themes in this study is based on my interpretations and approach to thematic analysis. I recognize that it is impossible to entirely eliminate bias when analyzing data, and it is possible that another researcher could have identified different themes from the data collected in this study. I also recognized that my experiences learning mathematics with English as a second language could have contributed to the design and interpretations of the experiences of the participants in this study. Recognizing that my experiences can influence the interpretation of the data was essential to maintain a focus on the participants' experiences when teaching mathematics to international students. However, I believe the themes identified in my thesis serve as a valuable contribution towards advancing our understanding in this area of mathematics education research.

5.4 Future Directions

In summary, much remains to be done. Few research studies have investigated the experiences of instructors when assigned to teach mathematics courses to international students at a post-secondary level. As my research illustrated, instructors experience a variety of challenges teaching mathematics to international students, more challenges than some of the participants had anticipated. On many occasions, the participants made efforts to adjust their teaching practices to support international students; however, there were occasions where they were uncertain on how to overcome the challenges presented in the classroom.

In the future, it would be appropriate to conduct follow-up interviews with the participants of this study to understand how they preserve and work with a language barrier as they gain more experience teaching mathematics courses for international students. Also, the repetition of the study with a larger sample would enhance the validity of my findings and provide a more general understanding of instructors' experiences. Additionally, it would be interesting to replicate this study with a larger group of instructors teaching at international student programs in other institutions. It is possible that international student programs in other institutions have different English proficiency requirements upon international students' enrollment in certain mathematics courses. This could result in different instructors' perceptions and experiences with the language barrier.

Also, it would be interesting to design a study using action research methodology involving the planning, implementing, observing, and discussion of modified lessons for international students. With this type of research methodology, we would be able to identify possible effective teaching strategies and instructor

training for teaching international students in post-secondary mathematics. I hope that the mathematics education community involved in advanced mathematics, including instructors and researchers, will become aware of the necessity of extending our knowledge on this topic.

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APPENDICES

Appendix A: Recruitment letter

Dear Mathematics Graduate Student or Instructor,

The Teaching Mathematics to International Students research study is seeking mathematics graduate students and instructors who teach mathematics courses at international student program to participate in an exploratory study of your experiences teaching courses for international students. Your email was identified because you are listed as a mathematics instructor for the international student program. The purpose of this study is to examine your experiences teaching mathematics courses for international students.

Participation in this study involves:

- Participating in an interview at the beginning of the study that asks about your prior experiences teaching mathematics and your background in mathematics (60 min)
- Being observed 2-3 times in the classroom followed by a post-observation interview (30 min)
- An end-of-study interview that asks you to reflect on your experiences teaching mathematics to international students (60 min)

We expect your total participation time to be at most 3.5 hours.

Participation in this study is voluntary. Participating or not participating in the study will not have an impact on your employment or standing in the Department of Mathematics at this university.

For more information about this study, please contact the principal investigator, Dr. Beisiegel, by phone at 541-737-8397 or email at mary.beisiegel@oregonstate.edu.

Thank you,

Mary Beisiegel
Principal Investigator
Julissa Valenciano
Graduate Student Researcher

Study Title: Teaching Mathematics to International Students (TMIS)

Appendix B: Verbal consent form

Title: Teaching Mathematics to International Students

Purpose. We are conducting this study to understand mathematics graduate students' and instructors' experiences teaching mathematics courses for the international student program. The findings of this project will be used for Julissa Valenciano's thesis.

Voluntary. You do not have to be in the study if you do not want to. If you decide to participate in the study, you do not have to answer questions you do not want to answer. You can also decide to be in the study now and change your mind later. Your decision not to participate or to participate in this study will not affect your standing in the Department of Mathematics, or your standing at the university.

Activities. The study activities include a 60-minute introductory interview, up to three classroom observations followed by 30-minute interviews, and an end-of-term interview. During the observations, Julissa will take field notes specifically on the language that is used to talk about mathematics; this will be the language you use when talking to students about mathematical ideas, definitions, examples, and so on. These interviews will be audio recorded. The recordings will be transcribed and participants' names will be replaced with their research ID numbers. The recording is required for participation in the study. You should not participate if you do not wish to be audio recorded.

Time. Your total participation in this study will last approximately 3.5 hours.

Risks. The possible risks or discomforts associated with the being in the study include being uncomfortable while being observed or answering questions in which you describe an uncomfortable situation. If these situations occur, you do not have to be observed or talk about parts of the observation that were uncomfortable, or you do not have to answer any questions that make you uncomfortable.

Benefits. We do not know if you will benefit from being in this study. However, you might experience benefits from reflecting on your experiences teaching mathematics to international students.

Confidentiality. To protect participants' confidentiality, we will assign each participant a randomly assigned research ID number and this number will be associated with data. For example, in transcripts of the interviews, rather than using a participant's name, we will use the research ID number. If we publish any papers related to this study, any information that participants provided that would identify them will not be included in the publication. There is a chance we could disclose information that identifies you. The information collected from you for this study will not be used or distributed for future research.

Payment. You will not be paid for participating in the study.

Contact information. If you have any questions about the study, please contact Mary Beisiegel at 541-737-8397 or mary.beisiegel@oregonstate.edu. You can also contact the Human Research Protection Program with any concerns that you have about your rights or welfare as a study participant. This office can be reached at (541) 737-8008 or by email at IRB@oregonstate.edu

Appendix C: Interview protocols

Initial interview questions

1. Is this your first time teaching a math course for the international student program? If not, which math courses have you taught before?
2. What other math courses have you been an instructor for? Including the math courses you have been a teaching assistant for.
3. Have you taught another subject other than math?
4. How would you describe your teaching style?
5. What are some of your most important classroom norms and expectations? How do you sent classroom norms for communication and for students to work together?
6. Do you speak another language(s), other than English? If so, to what extent are you fluent in this/these language(s)?
7. Have you been to other countries, other than the United States? For how long did you visit each country?
8. When interacting with a person from a different culture than your own, how do you ensure that communication is effective?
9. Did you receive any special training before teaching this course for the international student program? Follow-up question: Did this address how to teach a math course of international students?
10. Why did you decide to teach a course for the international student program?
11. How do you see yourself benefiting from teaching this class?
12. What kinds of qualities do you think international students look for in teachers?
13. In general, how would you describe your teaching practices?
14. Do you change your teaching practices when teaching a course for the international student program? If so, what do you change and why do you make the change?
15. What are some of the challenges you are expecting to have [or Are you experiencing any challenges] when teaching this course for the international student program? How do you plan to overcome those challenges?

First follow-up interview questions

1. I saw you _____. Can you tell me why you made that choice? Do you feel like you would have chosen a different strategy working with students who aren't international students?
2. What did you do in the lesson that helped students become more confident in working on or talking about mathematics?
3. I noticed that the students in your class were diverse/not diverse. How do you approach teaching a classroom of diverse/non-diverse international students?
4. I saw that you taught a lesson on _____. Do you feel like the language barrier was an obstacle for you to make a mathematical point during your

lesson? Are there strategies you've learned that help you overcome the language barrier?
5. How do you support communication about mathematics as a whole class and in small groups?
6. What do you think about students using their home language in the mathematics classroom? Do you encourage students with the same home language to talk about mathematics using their home language?
7. How do you group students with different language? Do you put them in groups with students with the same language or do you put them in groups so that all students in a group have a different language and thus have to communicate in English?
8. Do you try to learn any of the language or approaches to mathematics that your students bring to the classroom?
9. What other thoughts do you have about the lesson?

Second follow-up interview questions

1. I saw you _____. Can you tell me why you made that choice? Do you feel like you would have chosen a different strategy working with students who aren't international students?
2. What did you do in the lesson that helped students become more confident in working on and talking about mathematics?
3. I saw that you taught a lesson on _____. Do you feel like the language barrier was an obstacle for you to make a mathematical point during your lesson? Are there strategies you've learned that help you overcome the language barrier?
4. Have you noticed a large difference in language proficiency among your students? If so, how did you notice that? How much do you think this can influence students' participation in class?
5. When students contribute to the class discussion or answer one of your questions during lecture, how do you address students' English mistakes?
6. Has there ever been an occasion where you are having trouble understanding a students' comment or contribution? If so, how do you manage to understand a students' comment?
7. What do you think about the language use in the textbook and other class materials?
8. Do you encourage students to give presentations or talk in front of the classroom? If so, are there strategies you've learned that can help them feel prepared to give a presentation or talk? If not, why do you make this choice?
9. Is there any strategy you use to help minimize student anxiety levels when they are giving a presentation/talking in front of the class?
10. What other thoughts do you have about today's lesson?

Final interview questions

1. I saw you _____. Can you tell me why you made that choice? Do you feel like you would have chosen a different strategy working with students who aren't international students?
2. What would your students say they have learned after spending a quarter in your class?
3. What do you want students to remember about your class?
4. What do you think your international students appreciate from you as an instructor?
5. Do you think your students were learning English while learning new mathematical concepts in this class? If so, in what ways were they learning English in your classroom?
6. What were some of your expectations about the language difficulties your students were possibly going to face when learning mathematics in this class? How do these expectations compare to what you experienced?
7. How did you support your students with any of the language barriers they faced as they were learning mathematics in your classroom?
8. What did you learn after teaching this class? How would you apply what you learned in your future teaching practice?
9. Did you change your teaching practices when teaching this course for the international student program? If so, what did you change and why did you make these changes?
10. What did you learn about communicating with students from a different culture than your own?
11. Is there any teaching practice that you would want to implement if you were to teach a mathematics course for the international student program again?
12. What did you learn about yourself after interacting with international students?
13. In the front door of every classroom in the international student program, there is a sign that says "English only in class." What are your thoughts about having a "English only" policy in the classroom?
14. What recommendations/tips do you have for someone who will be teaching a mathematics course for the international student program?
15. What recommendations/tips do you have for students who are about to start a mathematics course in the international student program?
16. You mentioned that you did not receive any training before teaching a course for the international student program. What would be some of the suggestions about the training instructors should receive before teaching a mathematics course for the international student program?

Appendix D: Class Observation tool

Dimension	Code	Consider the following
Mathematical Content I	Mathematical concept delivery form	Modes (oral, written, receptive, expressive, etc). Multiple representations (including objects, pictures, words, symbols, tables, graphs, etc.) Different written texts (textbook, word problems, student explanations, teacher explanation, etc.)
	Adjustment of shipping	Attention given to students' reactions and leaning outcomes. If necessary, instructor changes form of delivery using different mathematical representations
Mathematical Content II	Materials and instruction	The organization of material helps students make connections of different mathematical ideas. Material and instructions address the what/when/where/why/how of each mathematical concept. Clarification of instructions.
	Language necessary for learning mathematical content	Unnecessary language is minimal on instructions, explanations, class activities, or/and lectures. Unknown words are addressed but main focus is the mathematical content.
Engaging Students and Mathematics	Classroom learning environment	Student-to-student interaction, students-to-instructor interaction, class discussion, lecture, etc.
	Assessment for learning	Instructor slows down if necessary and frequently asks questions to students. Provides adequate wait time for responses.

Mathematical language	Opportunities for students to practice mathematical language	Instructor provide different forms of participation (orally, in writing, graphically) for student to communicate the meaning of different mathematical situations.
	Appreciation of students' comments	When a student makes a contribution, instructor uncovers mathematical content building on the student's response. Asks for clarification or re-phases students' contribution.

Appendix E: List of Codes Used to Analyze Data

The list of initial codes was created after familiarizing myself with the data. I then used the following set of initial codes to analyze the interview transcripts multiple times.

- Instructors' backgrounds influences on teaching practices.
- Abandoning teaching practices used in previous classes.
- Supporting students' mathematical communication
- English vocabulary development
- Implementation of group work activities.
- Modifications of class materials.
- Communication techniques used by instructor.
- Awareness of different English proficiencies.
- Methods to assess students' knowledge in the classroom.
- Attitudes and perceptions of international students.
- Different education backgrounds.
- Establishing class expectations.
- Attitudes towards usage of students' native language in the classroom.