Teaching Mathematics in Multilingual Classrooms: Developing Intercultural Competence via a Study Abroad Program

Lisa Anne Kasmer
Esther Billings
Grand Valley State University

Abstract:

This study investigated how a study abroad experience teaching mathematics in Tanzania, Africa impacted a group of secondary education pre-service teachers (PSTs) from the United States. In particular we discuss their ability to facilitate the learning of students in multilingual mathematics classrooms while personally developing intercultural competence. We examined three areas: the PSTs' attitudes, knowledge and comprehension, and skills in an effort to understand their ability to teach in multilingual classrooms.

Background and Context
Intercultural Competence

In classrooms across the globe, multilingualism is widespread, as many students transition between the language spoken at home and the languages spoken in schools, and teachers must be prepared to meet the challenge of teaching in these classrooms. As people from different cultural backgrounds interact, especially within the context of the classroom, intercultural competence, "effective and appropriate behavior and communication in intercultural situations" (Deardorff, 2011, p. 38) is imperative.

Effective intercultural communication involves knowledge and proficiency in language (Braskamp, Braskamp, Carter Merrill & Engberg, 2012) as well as communicative awareness, an "awareness of the fact that other peoples' languages may express shared ideas in a unique way or express unique ideas difficult to access through one's own language(s), and awareness of the fact that people of other cultural affiliations may follow different verbal and non-verbal communicative conventions which are meaningful from their perspective" (Barrett, Byram, Lazar, Mompoint-Gaillard & Philippou, 2013, p. 9). Within the school setting, teachers and students should be able to ". . . consciously engage in successfully communicating and negotiating their cultural conceptualizations during intercultural communication" (Sharifian & McKay, 2013 p. 1). Teachers must possess the skills to effectively communicate with students from different cultures and appropriately engage in conversations based on mutual understanding and an attitude of openness and acceptance (TESOL, 2006).

However, language is not sufficient for ensuring meaningful communication and intercultural competence (Deardorff, 2011); attitudes (respect, openness, curiosity, and discovery), knowledge

(cultural self-awareness, culture-specific knowledge, and sociolinguistic awareness), and skills for processing and acquiring knowledge (observing, listening, evaluating, analyzing, interpreting and relating) are also essential (Deardorff 2006, 2009, 2011). Acquiring necessary knowledge entails recognizing the complexity of one's view of importance of cultural context when making judgments (Braskamp et al., 2012) as well as developing metacultural competence, actively assessing cultural aspects and specificities within a learning context and adapting to an evolving appreciation of diverse cultural realities (Meyjes, 2010). The development of different facets of intercultural competence is a continuing and ongoing process (Deardorff, 2006).

We claim there is a strong link between effective teaching in multilingual classrooms and the development of intercultural competence; in addition to effective intercultural communication with students, the ongoing development of intercultural competencies (attitudes, knowledge, skills) are critical to most effectively meet the learning needs of students. Yet, research indicates that many pre-service teachers (PSTs) graduate from institutions of higher learning without the requisite intercultural skills needed to ensure educational equity (Cushner & Mahon, 2009). Some researchers believe teacher education programs are doing little to prepare teachers to teach from a global perspective (Ukpokodu, 2010). With this in mind, we sought to determine whether and to what extent PSTs, through a month long field experience in a third world country (Tanzania), could facilitate the learning of students in multilingual mathematics classrooms and what, if any, characteristics of intercultural competencies the PSTs demonstrated as a result of their experiences.

Communication in Multilingual Mathematics Classrooms

Drawing upon Setati & Adler's (2000) description, we define a multilingual learner as one who speaks more than two languages; a multilingual classroom is one in which the teacher and students collectively speak several languages, but individually the teacher or student may not be multilingual. In this study, the multilingual classrooms were comprised of multilingual students and monolingual PSTs; English was the primary language of instruction and the students spoke and understood additional languages.

PSTs in the United States come to understand the importance of communication in the mathematics classroom through their university coursework. This is the perspective they operate under as they enter Tanzanian classrooms. Teaching mathematics in a communication-rich environment, and one in which the student is not proficient in the language of instruction, must extend beyond viewing language as words definitions, and expand include mathematical discourse as key for learning and making sense of complex ideas (Moschkovich, 2015). Research highlights that English Language Learners (ELLs) can contribute to mathematical discussions while learning English. As ELLs make sense of others' meanings and approximate and make use of English by participating in discussions, they also attain better proficiency of English (Mohan & Slater, 2005; Moschkovich, 2015).

Chval & Chávez (2012) identify a number of research-based strategies that support ELLs learning of mathematics in a communication-rich environment: connecting students' experiences and existing knowledge to the mathematics being studied; connecting language and mathematical representations; using visual supports including gestures, objects, illustrations in classroom discourse, emphasizing the meaning and multiple meaning of words; and creating a classroom

environment rich in both mathematical content and language. Since learning mathematics is dependent on communication, it is all the more crucial that PSTs develop intercultural competence in order to meet the learning needs of their students in multilingual classrooms.

Preparation of U.S. Teachers

Despite the increasing cultural and ethnic diversity of students in the United States (U.S.) K-12 classrooms, including a population growth of ELLs in the U.S. (Chval & Chávez, 2012), U.S. teacher demographics have remained fairly consistent (Cushner, McClelland, & Safford, 2009) as a homogeneous profession. The majority of U.S. teachers and PSTs are of European American descent; PSTs tend to be cross-culturally inexperienced, live within 100 miles of where they were born, and desire to teach in schools similar to those they attended with fewer than 10% hoping to teach in either an urban or multicultural setting (Cushner & Mahon, 2009). Cushner and Mahon also assert that less than 5% of U.S. teachers are fluent and able to teach in a second language, and PSTs spend the majority of their time with people of their own ethnic and racial group. Cushner, McClellan & Safford (2009) conclude that PSTs live in vastly different worlds from the students they will teach (as cited in Cusher & Mahon, 2009).

In order to close this gap between teachers and their students, Cusher & Mahon (2009) propose intercultural competency as central to teacher training programs; PSTs must be prepared, not only to facilitate the learning of students from different cultural backgrounds, but also to provide all students with skills to succeed in a globally-minded and culturally diverse world. Yet, McAllister & Irvine (2000) argue that current PST programs do not adequately develop intercultural competence.

Early Field and Study Abroad Experiences

However, we conjecture that early field experiences situated in multilingual and culturally diverse classrooms can provide opportunities for PSTs to begin to develop the requisite skills to develop intercultural competence and the necessary knowledge to better meet the needs of their multilingual students. Meaningful early-field experiences are crucial and clarifying for PST development; they can encourage and affirm PST's decision to pursue a career in teaching (Smalley & Retallick, 2011) and can positively influence PST's own views of teaching and ways of interacting with students (Mewborn, 2000). The type of experience, rather than its length, is most important for teacher development (McIntyre, Byrd & Foxx, 1996).

Heyl & McCarthy (2003) suggest that experiences in international education have the potential to be the most influential factor in developing intercultural competencies in PST education: "A key role for higher education institutions must be to graduate future K-12 teachers who think globally, have international experience, demonstrate foreign language competence, and are able to incorporate a global dimension into their teaching" (p. 3). Study abroad experiences can have long lasting effects on PSTs as they necessitate not only adapting physically and geographically, but also require complex thoughts, behaviors, and emotions to deal with cultural and language differences. As universities encourage participation in study abroad programs, one of the top nine trends in higher education (Dennis, 2003), it is vital to understand the complexity of a teaching-abroad experience in a culturally diverse environment, especially in Africa, as little is known about the effects in this geographic location unlike in other geographic areas such Europe (Lowe, Dozier, Hunt-Hurst & Smith, 2008). Other studies support the contention that international experiences enhance the

professional growth of PSTs (e.g., Myers, 1997; Pence, 2008; Thomas, 2006). Given the potential for significant development of intercultural competence during a study-abroad experience (Andersen, Lawton, Rexeisen, & Hubbard, 2006), especially one that supports a continuum of learning before, during, and after the international experience (Vande Berg, & Paige, 2009), it is important to document aspects of programs influencing intercultural competence development as this may serve as a springboard for future research regarding the development of PST's intercultural competence. Yet, few studies examine the factors contributing to the value of these experiences (Brindley, Quinn, & Morton, 2009) and little is known about the alignment of PST experiences in situ with the acquisition of intercultural competence and the ability to teach in multilingual classrooms.

Research Design and Methodology

Research Questions

In designing the methodology for this study and in formulating a specific set of research questions, it was clear that a qualitative or interpretive research design would more adequately answer the questions raised; as Pirie (1998) suggested, the research questions dictated the use of the methodology, not vice versa.

In particular, the main focus of this study was to investigate whether PSTs in a one-month study-abroad program in Arusha, Tanzania could facilitate the learning of students in multilingual classrooms from a cultural background much different than their own. Secondly, the study sought to identify what, if any, characteristics of intercultural competence did the PSTs demonstrate as a result of this study-abroad experience.

Although this qualitative study was not ethnographic in the sense of trying to understand a problem within a "cultural" framework, it shared many of the characteristics of this type of study as identified by Bogdan & Biklen (2003). The researcher was the main source evaluating and interpreting PSTs' responses, much of the collected data was descriptive, the researcher extracted meaning from the PSTs' perspectives, and data were analyzed inductively as a more holistic understanding was attempted.

Research Subjects and English Medium Schools (EMS)

Fifteen PSTs (mathematics education majors) supervised by two university professors spent one month teaching mathematics to primary and secondary students, during an ongoing study abroad program situated in Arusha, Tanzania. Tanzania provides a unique setting to study American PSTs' experiences and development of intercultural competence in multilingual classrooms. In Tanzania, English is typically the students' third or fourth language; the students' first language is their tribal language (there are approximately 120 tribal languages spoken in Tanzania) and/or Kiswahili and many students speak French as well. The PSTs in this study-abroad program taught at local, private, English-medium Tanzanian schools for 18 half days (spending approximately 60 hours).

Though English is considered the lingua franca in Tanzania, and few families speak English within the home, it is a language of power, prestige and opportunity and is a required subject taught in schools from preschool through the fourth year of secondary school (Rugemalira, 2005). At the primary level, Tanzanian children may attend either government schools where Kiswahili is the

language of instruction or private English Medium schools (EMS). English-medium private schools in Tanzania are non-profit entities administered primarily by churches (Samoff, 2002). These schools follow the same curriculum as the government-run schools and are registered with the Ministry of Education. Students participate in the Tanzanian National Examinations at the conclusion of each academic year, which are written in English. However, many students in the secondary English-medium schools matriculate from government primary schools, where Kiswahili is the language of instruction.

There are similarities between Tanzanian EMS and second language immersion schools found in other parts of the world, and Rugemalira (2005) compares African EMSs to a subtractive immersion school model, where the students' mother tongue is regarded as an obstacle and the school works to assimilate the learner to the dominant language (English) as quickly as possible. The fact that English is used as the mandated language of instruction for secondary schools in Tanzania in a society where English is not the mother tongue of most students produces a number of challenges. For example, since Tanzanian EMS practice a total immersion where all of instruction is conducted in English, Rugemalira highlights the challenge that students often learn new concepts for the first time in English. This raises the question of long term-consequence: how and when do students' literacy and academic proficiency in their mother tongue (Kiswahili) develop? Learning new concepts in a language for which the students are not proficient also raises the challenge of how students can understand what they are learning (Desai, 2013) and how they will acquire use and understanding of technical vocabulary (Mohan & Slater, 2005); learners need to be reasonably proficient in a language if it is to be used as a tool for learning. Furthermore, students are learning in English from teachers in EMS schools who often do not have a perfect command of English (Desai, 2013; Rugemalira, 2005) which exacerbates these challenges.

For the purpose of this study, data from eight secondary PSTs were analysed. This program is administered through a university in the midwestern region of the U.S. in conjunction with four English medium schools in Arusha. Arusha, Tanzania was selected as a study abroad site due to previous affiliations and the schools willingness to open their classrooms to the PSTs. These PSTs were a representative subset of the students in the university's study abroad program and epitomized the typical mathematics education majors at the university and research profile of a U.S. teacher in training. That is, the PSTs were white middle-class juniors and seniors (third and fourth year university students) who completed their mathematics course requirements (Calculus I, II, and III, Euclidean Geometry, Communicating in Mathematics, Linear Algebra I, Modern Algebra, Discrete Mathematics, Mathematical Activities for Secondary Teachers or Mathematics for Elementary Teachers, and Teaching Middle Grades Mathematics) and many education courses. They typically began their student teaching within a year after returning from Tanzania. The PSTs were selected to participate in this program through an application and interview process.

Prior to departure, students attended six orientation meetings in which they read and discussed articles about Tanzanian culture, history, and education, and learned basic conversational Kiswahili in preparation for the program, as 90 percent of the Tanzanian population is proficient in Kiswahili (Desai, 2013). A Kenyan faculty member also attended many of the orientation sessions to assist in the Kiswahili instruction and respond to questions from the PSTs about culture and language.

PSTs were placed in secondary classrooms where class size ranged from 24 to 50 students. The PSTs were responsible for teaching three or four mathematics classes daily. On their first day at school, the PSTs observed the Tanzanian teachers teaching and then began their field experience work the following day. From the first day of their field experience, the PSTs taught in the English-medium classrooms and met with the Tanzanian teachers when necessary to discuss the mathematical content to be taught.

In all cases, the PSTs were responsible for developing the lessons, determining the pacing of instruction, teaching the lessons, and designing assessments, often without textbooks, materials, or resources. The teaching day concluded with each PST individually conferencing with one of the university faculty members, followed by a whole group reflection. During this conference, each PST analysed and reflected on the mathematics lessons they taught and how their students engaged in the lessons. It should be noted that the university faculty assisted the PSTs with mathematical content and classroom management recommendations when needed. However, faculty did not offer explicit pedagogical suggestions related to how the PSTs should teach mathematics relative to mediating language in their classrooms; the PSTs navigated these issues individually or with one another. Specifically, if a PST struggled with a mathematical concept the faculty would help clarify the PST's mathematical understanding, but would not provide suggestions on how to teach the concept.

PSTs were immersed in the language and culture of Tanzania. All PSTs participated in bi-weekly Kiswahili lessons provided by a local instructor, and worked at a local orphanage once a week. They either walked or rode the local dala dala (bus) to school and had numerous opportunities to interact with the Tanzanian residents throughout the day. During the week, students resided at a small guesthouse. On weekends, they participated in organized excursions led by local guides in order to gain a broader view of the culture and geography of the country. One weekend, PSTs camped at a nearby village and learned about the Maasai tribe's way of life. A second weekend excursion involved hiking and exploring in the Kilimanjaro region where they learned about the customs and the day-to-day lives of the Chagga tribe. The third excursion was a four-day safari to the Serengeti and Ngorongoro Crater.

Data Sources

Data were gathered from the PSTs participating in the 2012 Tanzania study abroad program: data from the eight secondary PSTs were analysed and reported in this study. This study was designed to encompass a variety of sources in order to triangulate the data and enhance the validity of our research findings (Denzin, 2006; Lincoln & Guba, 2000). Data for this study were gathered from four major sources: conferences and whole group discussion (audio-taped), written artifacts provided by the PSTs, documentation of teaching and participant observation.

Conferencing.

Each PSTs participated in daily conferences (data were analyzed from ten conference sessions; approximately ten minutes in duration) over the course of the study abroad experience as a means to allow the PSTs the opportunity to report and reflect upon their instructional decisions, discuss what seemed to go particularly well and aspects of teaching they deemed problematic.

Documentation of teaching.

In order to capture the student/teacher interactions and instructional decisions made by the

PSTs, a sample of each PST's teaching was recorded using audio and video recording. These episodes were captured during the last week of the study abroad experience, and were carried out in a non-intrusive manner. (The two faculty members stood in the back of the room and videotaped teaching segments.)

Written artifacts.

The written documents collected for this study, were required components of the study abroad course. Each PST responded to blog post prompts during their time in Tanzania. While some of the blog posts did not pertain specifically to their teaching experience, prompts such as "First Day of School", "Back to School", "What I've Learned so Far", and "Lasting Impressions", provided insight into their struggles and successes teaching in these multilingual classrooms. Each PST also responded to a final reflection prompt upon their return to the U.S. "What do I Know Now that I Didn't Know Before?" In many cases this prompt highlighted their instructional decisions, and struggles and successes. PSTs' written lesson plans and reflections on their lessons also provided documentation of their instructional decisions pertaining to navigating teaching of mathematics in multilingual classrooms. Because reflection is a crucial component for intercultural competence and teaching in general, conferencing, reflection questions and blogging prompts provided multiple opportunities for self-reflection.

Participant observation.

A participant observer participates, at various levels, in the daily life of the people under study, either openly or in a disguised role. The lead researcher engaged in moderate participation throughout this experience, maintaining "a balance between being an insider and outsider, between participation and observation" (Spradley, 1980, p. 60). As participant observer, the lead researcher interacted and established rapport with the PSTs throughout all phases of the study-abroad program: she lived with the PSTs at a Tanzanian guesthouse, selected PSTs to participate in the program, directed pre-departure orientation meetings, accompanied PSTs on weekend excursions, and served as interviewer and instructor for the course in which they enrolled for university credit for the study-abroad experience. Field notes were taken to capture general impressions, interesting observations, and PSTs comments to further pursue in whole group discussions.

Data Analysis

The research questions dictated that the researchers use qualitative analysis methods to document and analyze ways the PSTs appropriately facilitated learning in multilingual classrooms and determine what, if any, aspects of intercultural competence they developed or expanded through this experience.

In order to make sense of and create order from collected data, a systematic analysis of the data was undertaken by organizing and synthesizing it, breaking it into manageable units, looking for patterns, and determining relevant themes as suggested by Bogdan & Biklen (2003). To analyze this data we utilized Spradley's (1980) method of data analysis which involves "systematic examination of something to determine its parts, the relationships among parts, and their relationship to the whole" (p.85) to guide the search for patterns and "domains" within the data. The initial phases of data analysis involved identification of "cultural domains" or categories of meaning (Spradley, 1980, p. 87). In order to identify these different domains, Spradley suggested the researcher ask specific

questions while reviewing the collected data. Sample questions the researcher might ask in order to classify may include: are there *kinds* of things here? Are there *ways to do* things here? Are there *reasons* for doing things here? Possible domains for this study included: strategies for teaching mathematics in a multilingual classroom, types of attitudes displayed, types of knowledge evidenced while planning/reflecting upon instruction, types of skills PSTs demonstrated, or nature of experiences leading to growth of an aspect of intercultural competence, etc. The search for domains continued throughout the study and these domains were used to further focus observations and analysis of the data. For example, identification of the domain "types of skills PSTs demonstrated" would lead the researchers to pose questions (guided by the questions suggested by Deardorff (2011)): How much do PSTs listen to the students? Do the PSTs engage in active observation at the school, paying attention to subtle nuances and dynamics among students, students/teachers? Do the PSTs engage in active reflection about their teaching practices with students from a culturally different background? Do PSTs know how to interpret interactions and learning situations through an intercultural lens, seeking to understand underlying cultural explanations?

The data were continually organized and reorganized. After identifying a large number of domains, ones that appeared most often were used as a springboard for further analysis. After continuing to organize and reorganize data and analyze it using the methods described above, the researchers transitioned from asking general questions about the study to asking more specific questions about ways PSTs facilitated learning in a multilingual classroom and aspects of intercultural competence that stemmed directly from the data. By identifying specific "cultural domains" and relationships among these domains, findings of the study identify for the educational community specific factors (as well as descriptive analyses/narratives of these factors) contributing to PST's development of intercultural competence within a multilingual context.

Results

In this section, we (1) describe ways PSTs facilitated the mathematical learning of students in multilingual classrooms where students came from a cultural background considerably different from the PSTs and (2) what characteristics of intercultural competence were demonstrated and developed via this study abroad experience in Arusha, Tanzania. As noted earlier, we report our findings about these aspects of intercultural competence: (1) attitudes (respect, openness and curiosity), (2) knowledge and comprehension (sociolinguistic awareness and cultural knowledge), and (3) critical thinking skills (especially the ability to listen, observe and evaluate, analyze, interpret and relate).

Characteristics of Intercultural Competence: Attitudes

The development of intercultural competence is cyclical in nature. In order to facilitate the mathematical learning of students in these multilingual classrooms the PSTs quickly became aware that in order to have a positive experience and gain both personal and professional growth in a culture much different than their own, attitudes of respect, openness, and curiosity were fundamental.

Developing openness and respect.

Openness, as described by Deardorff (2011) is the ability to withhold judgment. At the onset of their experiences in the schools, the PSTs were often judgmental about the Tanzanian teachers and

made comments such as, [the teachers] "don't teach like we do", "they are too strict with the students", "the schools seem very disorganized" and "having students copy from the board, seems like a waste of time". Initially, the PSTs believed the teachers were not very welcoming, and seemed to be "bothered by our presence in their schools". They soon realized that many of the Tanzanian teachers needed time to trust, feel comfortable, and demonstrate a willingness to share information. Over the course of the month there seemed to be a shift in PSTs attitudes about the teachers, and the schools in Tanzania. As the PSTs became more comfortable interacting with the teachers (and the teachers more comfortable with the PSTs) they began to inquire about teaching in Tanzanian classrooms and the school culture. Having the opportunity to spend "tea-time" with the teachers daily provided an avenue to learn more about the educational system in Tanzania. During this time the PSTs interacted with the teachers, asked questions about the structure and organization of the schools and teacher preparation. "We also asked the teachers countless questions about the sequencing and methods of their teaching, and this information was very helpful when planning our lessons." In addition, course readings along with class discussions provided the PSTs with relevant background information about the nature of education in Tanzania, created opportunities to consider various perspectives about teaching and teachers in their respective schools, and precipitated more questions to ask of the teachers. These exchanges and knowledge also enhanced their respect, as they began to value the culture of the school setting and country.

Curiosity.

Initially, the PSTs did not know what to ask of the teachers. However, the PSTs' growing curiosity became apparent when they began asking questions pertaining to the Tanzanian teachers' families, customs, and Kiswahili. One PST commented that, "I learned so much Swahili and I really enjoyed how much our teachers at our school helped. They were giving us new words everyday and then they would quiz us before we left. Learning Swahili also gave me another connection into Tanzanian life." It seemed as though the more curious the PSTs were, the more open and respectful they became of the culture. Another PST believed,

> [B]eing able to learn from them was so important and I think as the teachers started to understand that we were there to learn and not to teach them per se, they started to open up and even ask us questions. Swahili was a great way to start conversations that then led to many deeper conversations that helped teach me so much. I learned so much about the Tanzanian culture and their way of life by simply talking to the teachers in the teachers' room.

While the PSTs continued to ask the teachers questions about Kiswahili they still struggled with their own acquisition of Kiswahili. The PSTs began to appreciate the difficulties their students faced. They often commented, "I now know how the students must feel (regarding learning a new language)", "This is more difficult than I thought" and "I can't remember all these words".

The PSTs' developing curiosity, and their openness and respect for a new culture, served to enhance and benefit their ability to teach mathematics in these multilingual classrooms. For without these attributes and their own struggles learning Kiswahili, the PSTs would not have been willing to consider alternative views or strategies to effectively teach mathematics in these multilingual and culturally diverse classrooms.

Knowledge and Comprehension in Multilingual Classrooms

While cultural self-awareness is a critical aspect of knowledge and comprehension, analysis of the data was limited to sociolinguistic awareness and culture-specific knowledge, as cultural self-awareness was beyond the scope of this study.

Characteristics of intercultural competence: Sociolinguistic awareness.

An important aspect of intercultural competence and socio-linguistic awareness is the ability for teachers to adapt their behaviour and communication style to meet the learning needs of their students in multilingual classrooms (Deardorff, 2011). In terms of teaching mathematics, the PSTs negotiated instructional decisions based in part on the challenges they faced themselves learning Kiswahili, along with the information they gained from their interactions with the Tanzanian teachers. For many of the Tanzanian students (and teachers), English typically is their third language, however English is the prescribed language of instruction in English medium schools. In some homes, Kiswahili is the spoken language, while in other homes one of the 120 tribal languages is spoken. For the secondary students who matriculated from government primary schools, Kiswahili was the language of instruction, and the students faced learning mathematics in English. Secondary students who matriculated from English medium primary schools had been taught in English, though many were not considered fluent. Teaching mathematics to secondary education students presents numerous challenges within any classroom environment. A multilingual classroom compounds these challenges as students face learning mathematical concepts while attempting to negotiate the nuances of a language with which they are not particularly fluent. The PSTs grappled with how to most effectively teach their Tanzanian students mathematics in a way that they could understand the concepts they attempted to convey by both considering the language issues as well as the mathematical content issues.

Negotiating meaning for mathematics vocabulary.

The socio-linguistic awareness presented in a number of ways. On a number of occasions at the beginning of their teaching experience in Tanzania the PSTs remarked that, "the students don't understand me" or "I'm not really sure what the students are saying". When the PSTs reflected as a group, they came to the realization that while they spoke and understood a very limited amount of conversational Kiswahili, attention to mathematical vocabulary was foundational in teaching mathematics and often these terms do not easily translate between languages, an issue well-attested to in the research literature (e.g. Nation & Webb, 2011, Zevenbergen, 2000).

Code switching: translating math terms into Kiswahili.

In order to effectively communicate the meaning of mathematical vocabulary, the PSTs became aware of the fact that it was necessary to make adjustments to their delivery of instruction. Consequently, when planning to teach future lessons, the PSTs carefully thought about each mathematical term they would use while teaching, and then intentionally learned the Kiswahili equivalent of the term. They commented that it was important to ensure that the students understood the mathematical vocabulary in order to help facilitate learning; the PSTs understood that if they were unsuccessful in conveying the information speaking in English, they would have to rely on the Kiswahili translation. For example, when the Tanzanian students were confused by the word *equation*, the PSTs learned the Kiswahili word *usawazishaji* to help the students understand the

intention of their question. The PSTs commented that this code-switching approach of using the Kiswahili term "made a big difference", and "the students seemed to appreciate our willingness to help explain words in Kiswahili". However, other mathematical terms such as *area* have multiple translations in Kiswahili (*uwanja, mahali, eneo,* and *mahala*) and the exact translation is often difficult and in some cases not possible. When mathematical terms did not translate directly, some PSTs struggled to find an alternative instructional strategy to convey the meaning to the students. All PSTs understood that beyond making sense of the mathematical vocabulary, developing a deep understanding of the mathematics was also necessary.

Pairing students of varying English proficiency.

The PSTs also realized that using Kiswahili for mathematical terms alone would not ensure their Tanzanian students would learn the mathematics they were attempting to teach. One strategy the PSTs used to promote mathematical understanding was to pair the students who were more capable of understanding English with those students who had lower proficiency in English. While it was understood that English was the language of instruction in the secondary schools, the PSTs would often rely on those students who were more proficient in English to help explain in Kiswahili to ensure that all students had equal access to learning mathematics.

Non-verbal mechanism for conveying confusion or limited understanding.

Another instructional strategy that many of the PSTs began to use in their multilingual classrooms was providing their students a mechanism to convey when they did not understand what the PST was saying or did not understand the concept. Initially this was difficult for the Tanzanian students to do for a number of cultural reasons (embarrassment, fear of punishment, etc.). The PSTs continually encouraged their students to raise their hands when they were confused and ask for clarification, used "thumbs up" (to indicate understanding) or "thumbs down" (to indicate confusion), walking around the classroom and checking in with each student individually, or asking them to write their questions at the end of the class session for the PST to re-explain during the next class period. The PSTs demonstrated critical thinking skills, in relation to intercultural competence, as they made instructional decisions; by listening to and observing their students the PSTs provided opportunities for their students to express confusion.

The PSTs realized, however, that translating vocabulary from English to Kiswahili, pairing students with more capable English speakers, or checking for comprehension was not always adequate in order to make the mathematical learning goals accessible to all students. Many of the PSTs reported that they became "good at reading their faces", meaning, the PSTs were able to observe the Tanzanian students' facial expressions, and deduce that they were confused or bewildered with what the PST was verbalizing. In these cases the PSTs reported they would often "have to regroup and think of another way to present the mathematics".

Gesturing.

One of the ways they would do this was by gesturing. McNeill (1992) stated that gestures are "an integral part of language as much as are words, phrases, and sentences" (p. 2). Shein (2012) offers the notion of gesturing as an important component for English Language Learners (ELLs) to communicate mathematics. The PSTs were often seen "drawing" triangles, perpendicular, and parallel line segments in the air, as they verbalized the mathematical term they were trying to explain.

While gesturing is also prevalent in the monolingual classroom, this instructional strategy became an important instructional tool for the PSTs, when they were uncertain as to an alternate way to convey meaning. In the classrooms the PSTs would also communicate directions with gestures to indicate, for example, "listen" (pulling at their ears), "come together" (moving their hands together), and "pay attention" (pointing at their eyes). The use of gestures and pictures along with verbalization provided all students access to the mathematical ideas, as these non-linguistic representations are easily understood (Shein, 2012). As one of the PSTs described, "I've learned how to communicate a lesson without many words".

Pace of speech.
The PSTs also came to the realization that it was important to speak at a much slower pace and be cognizant of their word choices. At the onset of their teaching experience in these multilingual classrooms, the PSTs spoke at the same rate as they did when conversing with one another, and often used words that had no meaning for their students (e.g. describe, notebook, partner, eraser). After observing the confusion and bewilderment of their students, the PSTs recognized the implications of their typical modes of communication and needed to make adjustments to their speech patterns. Within a few teaching sessions, the PSTs were speaking at a much slower rate, and began to use more simplistic or understandable words during instruction.

Aspects of socio-linguistic awareness evidenced in the PSTs' mathematics classrooms were akin to the "dilemma clusters" suggested by Adler (2002). She claimed three essential "dilemma clusters" necessary in order to effectively teach mathematics in multilingual classrooms: (1) code-switching (switching between languages in class), (2) mediation (negotiating dilemmas that arise as teachers shift toward learner-centered practices requiring mathematical talk by learners), and (3) transparency (of language, where teachers explicitly highlight mathematical language). While these indicators were never explicitly or implicitly taught in the PSTs' coursework, as a result of the PSTs developing intercultural competence, they demonstrated these dilemma clusters in their mathematics teaching.

Characteristics of Intercultural Competence: Culture Specific Knowledge.

Understanding the importance of greetings.
While not specifically associated with teaching mathematics, but certainly significant in developing intercultural competence, the PSTs recognized early in their experience in the Tanzanian schools, the importance of greetings. In Tanzania, greetings are an integral part of any interaction and can often take up to five to ten minutes. Once the PSTs became more comfortable speaking Kiswahili they appropriately greeted the teachers, the students, and staff at their respective schools. This social convention was important in establishing relationships with the school personnel, and students; the PSTs worked to build trust so they would be respected within the school environment.

Culturally relevant contexts.
Using gestures, Kiswahili words, and other strategies were not always sufficient for conveying mathematical meaning. Another important strategy for communicating related to culturally relevent contexts the PSTs provided to situate the mathematics they were teaching. Perso (2003) confirmed this instructional practice, "the relevance of any mathematical context to a particular group of students, their cultural background, and the subsequent practices of the students and their families are all factors that must be considered by the teacher if meaningful learning is to occur" (p. 15).

Initially, many of the PSTs attempted to provide a context to the mathematics they taught. However, since they used examples from a U.S. rather than Tanzanian context, they were met with perplexity and puzzlement among the Tanzanian students. For example, when attempting to teach angles and parallel lines, one PST utilized the context of miniature golf. Since the Tanzanian students were not familiar with this game, they could not attach meaning to what she was trying to convey. Upon reflecting and analysing this lesson, the PST recognized the context she provided was meaningless to the students. She remarked, "How can they make any sense of what I'm talking about (referring to angles and parallel lines), when they don't understand what miniature golf is?" She incorporated *kangas* (a rectangle of pure cotton cloth with a border all around it, printed in bold designs and bright colors) into her geometry lesson, and then used this same context to also teach symmetry and reflections. When she changed the context to a culturally relatable idea, the confusion dissipated. Not only was this context useful to help facilitate understanding of mathematics, (the PST indicated an increased number of students responding to questions she posed, the ability to explain concepts to other students, and performance on quizzes created by the PSTs) but the PST also demonstrated cultural knowledge, as her examples drew from aspects of Tanzanian culture all her students could relate to. One PST remarked, "This was a vital portion of my teaching, because there were many topics that required problems to be contextualized". After initial lessons that did not go well, the PSTs understood that it was necessary to create contexts that were relevant to the students' lives, not their own. The PSTs also believed that their students appreciated them creating meaningful contexts for learning mathematics, and possibly served as another avenue to create a common bond.

Skills for Processing and Acquiring Knowledge

In addition to attitudes and knowledge, developing skills of listening, observing, evaluating, analyzing, interpreting, and relating skills increased the PSTs ability to teach in their multilingual classrooms.

Relating.

In terms of relating, the PSTs came to realize the importance of connecting with their students. While this is certainly true in any classroom, all of the PSTs understood that in order to effectively teach mathematics in the Tanzanian classrooms they needed to "share a common bond", especially since they did not share a common native language. In the secondary schools, one of these common bonds became football (soccer) and netball. At the onset of the experience, PSTs observed the students' enthusiasm and frequency for playing football and netball and asked to join the game. During breaks and after school, the PSTs and their students could frequently be found at the football field. This connection gave both the PSTs and students an avenue for conversation and an opportunity to relate to one another outside of the mathematics classroom. A residual effect of these outside-classroom activities was a relevant context to teach mathematics. On a number of occasions, the PSTs were observed referencing a football game in order to attach meaning to the mathematical concept they were attempting to teach. One such observation occurred when a PST taught a lesson on perpendicular and parallel lines. They also incorporated the notion of kicking the football with respect to angle measure. While many teachers in homogenous language classrooms understand the significance of relating to students, the PSTs verbalized the importance of fostering common bonds and communicating with their students on a personal level. They expressed that in order to facilitate and promote a nonthreatening classroom environment, where students felt

comfortable expressing the inability to understand concepts or language, relating to students was critical. The ability to relate is a critical characteristic toward developing intercultural competence and in turn supports students' learning in multilingual classrooms.

Listening, observing, evaluating, analyzing, and interpreting.
In order to facilitate effectively the mathematical learning of students in these multilingual classrooms it was necessary for the PSTs to listen, observe, evaluate, analyze, and interpret their daily interactions with both the students and teachers with whom they came in contact. These active skills contributed to the development of their sociolinguistic and culture-specific knowledge that was detailed earlier; as students listened, observed, analyzed, and interpreted their interactions in the classroom, school, and society, the PSTs developed strategies such as code-switching, gesturing, using non-verbal signals, cultural contexts, pairing of students with varying levels of English proficiency and others to facilitate effectively mathematical learning. That is, to make productive instructional decisions the PSTs had to be constantly engaged in these actions, which went hand in hand with the development of their intercultural knowledge.

Evidence of Learning
Consequently, the instructional strategies the PSTs used in conjunction with their development of different aspects of intercultural competence in these multilingual classrooms, resulted in mathematical learning as evidenced by: PSTs reported passing scores on PST-developed assessments, Tanzanian teachers commenting on their students' progress, and the Tanzanian students' willingness to respond to questions or go to the board and share their mathematical work. One headmaster commented, "I enjoy watching your teachers teach. They help our students understand".

Conclusion
The PSTs in this study did appropriately facilitate students' learning in multilingual classrooms with students from cultural backgrounds much different than their own. As the PSTs developed characteristics of intercultural competence, specifically (1) attitudes of respect, curiosity, and openness, (2), knowledge and comprehension, and (3) skills for processing and acquiring knowledge within a culture much different than the PSTs, the PSTs learned to teach in a way that their Tanzanian students could learn mathematical skills and concepts.

Teaching mathematics is a complex undertaking. Teaching mathematics in multilingual classrooms compounds these complexities. We claim, that in order to effectively promote learning mathematics in multilingual classrooms, teachers must begin to demonstrate characteristics of intercultural competence and that developing intercultural competence can significantly impact PSTs' ability to teach mathematics in multilingual classrooms. Even though these PSTs will not be teaching in Tanzanian classrooms upon graduation, participating in a field experience in a multilingual classroom enabled the PSTs to grow and develop their intercultural competence.

While this field experience provided a number of opportunities to facilitate learning in these multilingual classrooms as they moved toward intercultural competence, it also created challenges. As the PSTs found success in navigating many of the issues they faced teaching mathematics in a multilingual setting, they continued to negotiate difficulties throughout this experience. Specifically,

how could they reach the students who were not particularly fluent in Kiswahili or English, what instructional strategy could they use when no one in the class understood the PST, and how might they create a relatable context if one didn't easily come to mind? With this in mind, we must also consider bigger questions such as: How do we better prepare PSTs that do not have these types of experiences in multilingual classrooms? Is there specific content we should consider including in PST coursework related to teaching mathematics in multilingual classrooms and developing intercultural competence? What opportunities are available for monolingual in-service teachers to learn these skills?

The desire to ensure mathematical understanding and success for students in multilingual classrooms seemed to be the primary motivation for the PSTs to continue to reflect upon and revise their instructional practices. Faced with a majority of their students finding minimal success understanding mathematics through English instruction, it was necessary to make modifications "to maintain the flow of instructional activities". These modifications would be unlikely had the PSTs not developed some degree of intercultural competence. As one student stated,

> The experience I had in Tanzania taught me many things about myself as a teacher, a student, and as an individual. I was able to push myself beyond my comfort zone and open myself up to a new culture. I learned a great deal about the differences between Tanzania and the United States, but also saw many similarities that expand across humanity, creating a common bond between all people.

No matter where PSTs teach upon completion of their program, it is important that they are provided opportunities to begin to see this common bond and develop intercultural competence in order to enhance their ability to interact and teach mathematics in classrooms that are multicultural, multi-linguistic, and multi-ability.

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