

One Multilingual International Student's Experience in Collegiate Mathematics Classrooms

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Although the number of multilingual international students is increasing in undergraduate mathematics classrooms, there is little research about this population at the collegiate level. To better serve this growing population, it is important to understand their experiences using multiple languages in their mathematics learning. In this study, I constructed a narrative of one multilingual international student, Jia. I used narrative inquiry as a research method and collected data from synchronous- and email interviews and observations. The narrative demonstrates how Jia used her Chinese and English and how she dealt with her challenges. The study found that engaging in groupwork was particularly challenging for her as a multilingual student. I focus on not presenting her multilingualness as a deficit feature and discuss how to mitigate challenges multilingual students can face in their mathematics learning.

Keywords: Multilingual, Active Learning, Groupwork, Linguistic Diversity, Narrative Inquiry

In the increasing globalizing world, the number of international students in collegiate classrooms worldwide has likewise been increasing, especially in undergraduate mathematics classrooms in the United States. When international students move from their home countries to the U.S, they bring much diversity into the classroom: racial, cultural, and linguistic, to name a few. I mainly focus on linguistic diversity in a mathematics classroom because having a different first language than the language of instruction (LOI) is directly related to communication, which can impact one's access to learning opportunities and mathematics identity. Despite a substantial portion of international students in undergraduate mathematics classrooms, such students' experiences have not received enough attention in the field. Researchers have focused on multilingual students' experiences in K-12 mathematics education (e.g., Huitzilopochtli et al., 2021; Moschkovich, 1999; Takeuchi, 2016; Turner et al., 2013), but there has not been much research at the undergraduate level, especially in multilingual international students in the U.S. Collegiate mathematics classrooms are likely to be more diverse in terms of students' home countries and languages that they bring compared to K-12 mathematics, where *bilingual* classrooms—classrooms that have two main languages such as Spanish and English—are more common for K-12 mathematics education study (e.g., de Araujo et al., 2018; Domínguez, 2011; Moschkovich, 2007).

In this study, I present a narrative of Jia's (pseudonym) experience answering the following research questions: *What is Jia's experience as a multilingual international student in college mathematics classrooms? How does she use her languages in college mathematics classrooms?* Jia's narrative reveals what challenges some multilingual international students experience, how they might feel or be positioned in mathematics classrooms, and how multilinguals use multiple languages in their mathematics learning. From this study, I call for more attention to multilingual international students in undergraduate mathematics classrooms from the mathematics education field so that the field can better understand the population and serve them more equitably.

Relevant Literature and Theoretical Perspectives

In this study, by multilingual, I mean people who use one language in some situations and another in other situations (Planas & Setati, 2009). This definition does not imply that multilinguals need to speak both languages fluently as if both are their native language, which is a common understanding of the term multilingual (Planas & Setati, 2009). According to this,

international students who are traditionally described by terms such as “English as a Second Language,” “English as Another Language,” or “non-native English speakers” are “multilingual” as they use English during the official instruction of the course as well as some other contexts and often use their first language in other settings.

When multilingual international students move to the U.S. from their home country, their pattern of language use changes: the language that they use in their home country loses its position as the LOI and English—which is usually not a significant portion of their language use—takes the position as the LOI. The switch of the LOI is one of the challenges international students report (Brenner, 1998; Macintyre et al., 1998). Although their language usage changes regardless of various disciplines, mathematics becomes one of the contexts that require a specific discourse (Sfard, 2008). One of the common myths about mathematics is that “mathematics is language-free” because it uses its own symbols and equations (e.g., Schleppegrell, 2007; Takeuchi, 2016). However, even though students share the same mathematical symbols, they need to translate when they want to verbalize their interpretations because mathematical sentences with symbols are dense. Sfard (2008) construed mathematics objects as discursive constructs and hence argued that doing mathematics is having a discourse of (mathematical) discourse, which requires intense language use. Therefore, mathematics needs significant language use to perform, which means multilingual international students whose first language is not the LOI can struggle with mathematical languages. Language is a primary and unavoidable medium when people in classrooms communicate; hence, it can influence students’ learning opportunities (Meyer et al., 2016).

Moschkovich (2002) reported that in the past, people had focused on multilingual students’ experiences from the perspectives of monolinguals who use the LOI, such as focusing on acquiring vocabulary in LOI or building different meanings of words and grammar in the mathematics. It was not difficult to find when researchers focused on what multilingual international students do not do well, such as concentrating on not speaking English as fluently as native English speaker students do. Some researchers have framed or assumed that multilingual students have linguistic deficiency implicitly or explicitly and then studied how that deficiency influences their learning and experiences (Campbell et al., 2007; Hwang et al., 2022; Neville-Barton & Barton, 2005). I encourage mathematics educators to avoid using such deficit perspectives to understand multilingual students’ experiences. Rather than focusing on what they cannot do, researchers need to focus on how students use their multiple languages in their learning and what their current experiences are in their mathematics education (Barwell, 2018; Moschkovich, 2002). Therefore, in this study, I focus on the mathematics identity of one multilingual international student, Jia, specifically focusing on how she used her repertoires of Chinese and English in proof-based undergraduate mathematics classrooms.

Language as Sources of Meaning

In this study, I adapt the view of Barwell (2018), who viewed language as sources of meaning. This perspective implies that language is fluid, agentive, and stratified. Barwell claimed that meaning-making is situated locally through utterance, which can evolve depending on the new utterance. Also, language is agentive as spoken language has the speaker’s intentions connecting the past- and current speaker’s intentions. Lastly, language is stratified because there were cases when people valued specific languages more than other languages, such as mathematical language and daily language in mathematics classrooms or English and other languages in U.S. classrooms. According to this perspective, language is social and political

(Barwell et al., 2007). It provides a lens to study the role of languages in students' interactions and experiences and their learning of contents.

Method

Part of the data used in this paper was collected as a part of a larger project that investigates students' agency and autonomy in the Introduction-to-Proof (ITP) course and some subsequent proof-based mathematics courses at a large public university in the Midwestern U.S. Jia volunteered to participate in the study in Fall 2019 while she was taking the ITP course. During the ITP course, two in-person interviews and seven activity logs about students' experiences related to the course were collected each week. I observed the course roughly once a week. The two in-person interviews were transcribed from the audio recording, and then I open-coded the data to find an initial list of the codes from her interviews and observations. After that, I found the themes in the initial list and then wrote a profile for her experience. In Fall 2021, follow-up questions specific about her experiences as a multilingual were asked via email interviews, given her preference. I received 12 email responses to the interview questions from Jia in the semester and the following semester. Each email response was analyzed to find initial codes of events (e.g., her group work experience in one ITP class or her use of Chinese in mathematics learning) and themes (e.g., her challenges related to languages) and to create the next set of questions. It was a repetitive and cyclic process. Once the data collection with her was finished, I found the themes (e.g., her challenges related to languages, or her experiences related to gendered bias) across the first and second rounds of data collection and built a narrative of her experiences. To deliver her story more vivid, I decided to use the first-person perspective for her narrative. After I wrote a narrative, I did member checking with Jia twice to have her agree on our narrative of her. Even with member checking, I acknowledge that there is no only "right" or "valid" way of her narratives, and it can evolve over time.

In the following section, I provide only a part of Jia's narrative that I wrote as our finding because of the constraints of the space. The whole narrative consisted of four parts 1) introducing herself, 2) challenges that she experienced in the ITP course and subsequent courses as a multilingual, 3) her ways to utilize her languages in mathematics learning, and 4) her motivations to pursue mathematics even with these challenges. For the sake of this paper, I wanted to highlight and call for attention to the challenges one multilingual student was experiencing, and hence first two parts were included.

Narrative of Jia

My name is Jia. I am a female Chinese, was born in China, and lived there until I came to the U.S for my undergraduate education. So, Chinese, or Mandarin, is my first language and English is my second language. As I am studying in the United States, the language "officially" used in the classroom is English, which I had some concerns with. As my major is statistics and minors are Computational Mathematics Science and Engineering (CMSE), data science, and mathematics, I have taken a lot of mathematics courses. Of course, languages matter in other disciplines as well, but today I am telling you about my experiences in mathematics courses.

Challenges in the Introduction-to-Proof Course

One of the mathematics courses that I remember is the Introductions-to-Proof course. I took the course in the fall semester of my sophomore year, and, as its name indicates, it was a transition course between Calculus courses and more proof-based mathematics courses. Actually, before the course started, I did not have a lot of ideas about the course. I asked some of my

Chinese friends and they said that the course is not difficult, but hard to do perfectly. They said that sometimes it asks you to explain your thoughts, but it can be quite difficult for international students, like us, to express thoughts clearly. And, I started to agree with them as the course was going on. There were several points that I was worried about my English while taking the course although I did well in this course. Sometimes I could not understand what the problem was asking to me or had difficulties understanding the definition, and other times were difficult because of the interactions with other people, like with the instructor or groupmates. I think these challenges were both from my language and my education, which are different here content-wise and teaching method-wise.

One of my biggest challenges was that the ITP course was based on groupwork. We had a lot of groupwork in the course, about two-thirds of the class each week was set aside for us to solve problems in groups, which I enjoyed and found helpful in general because groupwork helps me come up with some ideas or understand the material that I could not understand from my instructor's explanation... as the ITP course changed groups somewhat regularly, my experiences were diverse. The first week, we formed a group based on where we were sitting... I wanted to have some familiar people in the class, so when I stepped into the classroom, I went to a Chinese female student. And then, there was another Chinese female student, so we became a group. We added each other on WeChat (a SNS that mainly Chinese use) and became good friends, and we sometimes asked questions about the class. (Actually, I became a good friend with one of them and we still hang out sometimes.) As we sat close to each other, they became my groupmates for the first two weeks in the class, which was a good experience for me. I liked it because I could use Chinese with them, which I think is efficient.

After that, my instructor and TA switched groups roughly every two weeks during the first half of the semester. The TA somehow generated the groups and wrote them on the board. And then, I started realizing that who I am assigned to work with in a group influences my groupwork experience. None of my second groupmates were Chinese and all of them looked like their first language was English. I think communication between groupmates is important. But, in this group, I felt isolated. No, let me rephrase that: I was not very engaged. The other people in the group were discussing enthusiastically, but I was like in an, "Ahh, yeah- (indifferent)" kind of mode. I felt my language was the biggest reason. I felt like I did not speak that good.

I always had ideas about how to solve the problems, but I could not explain my thinking succinctly and effectively, or I was not sure whether the words that I wrote were expressing my thinking in English. It happened several times in that semester. For example, something like this: Once, we were asked to compare a variable, x , with a number. In those processes, our group missed that x is a negative number and that led us to make a mistake by not changing the direction of less than or greater than sign (e.g., $>$ or $<$). I said, " x is negative, so we need to change the signal" and they did not understand what I was telling them. I was expecting some positive reactions from them, like "Oh, yes, that's the point," but they did not get it and so could not give me such a reaction. Because I was not sure how to say it any other way, I just wrote it down on my note and showed it to them. Then, one of the groupmates understood and he explained that to the other people. It was a little bit frustrating, but this kind of experience was common at that time. After some of those experiences, I started staying quiet because I knew other people would usually say the same idea that I would have if I waited. Of course, if it took too long, I spoke about my idea, but sometimes I felt I was wasting others' time because other people just could explain the idea in one sentence.

I did not think my experience was challenging only because I did not know how to explain mathematics in English. One other reason that I remember was that, sometimes, I could not be sure which ways or methods they learned to approach the same type of questions in their mathematics in their K-12 education. I thought we all would have learned similar mathematics, but it seemed not. I think it made the situation harder because I think that it would have been easier if we all had similar background knowledge about mathematics. Another part of my experience that I think added more difficulty was that I could not easily jump in on their small talk. This could also be related to my personality; I don't think I am a very social person. But sometimes they speak fast or say things about things from outside the classroom that I did not understand, and then I felt excluded. But I still thought that it was better than doing all of the work alone.

After another round of group rotations, I again was in a group with my friends from the first week as well as another Chinese female student. About middle of the way through the semester, our instructor sent us a survey asking if we had a preference on whom to work with and if so, who we wanted to work with. I put the three Chinese female students on my list, and so did the other three. So, we became a permanent group for the rest of the semester. I was very happy with the group because I felt our communication was so efficient; being able to speak Chinese reduced the time we needed to explain what we were not understanding in English. Compared to when I was in groups where there was the pressure that I needed to explain things precisely, which made me stutter and feel even more nervous, it was so easy to communicate. I became a lot more talkative. We could do small talk as well, and I enjoyed talking with them about my life outside the classroom.

Thinking back, I should have encouraged myself to step out of my comfort zone more. Now, I just try to express my thoughts as clearly as I can. And I will encourage others, as well, if they are in a similar situation. I thought about what I would have done if I were in China and some of my classmates were international students who were not speaking Chinese perfectly. Actually, I had an experience similar to this situation although it is not in school. I once went to a shopping mall in China, and one international traveler came to me and asked a question. But, his Chinese was not very good and so he expressed with some Chinese words with body languages. I answered both in Chinese and English, but he did not understand. I was not mad but patiently explained one more time with gestures. I did not think he bothered me, I knew he needed help, and it was not a waste of my time. Then, I realized that I would have been patient and willing to listen to those international students who do not speak perfect Chinese. I think that it should be the same in the U.S. What do you think?

Jia's Ways to Leverage Multiple Languages

When I was stuck, as I said just before, I search online or ask my Chinese friends. For instance, I struggled a lot in my Abstract Algebra I course. As the course was so challenging, I needed to re-learn the material from resources I found online. When I searched for the course materials online, I could find some parts of some textbooks as well as lecture notes about the course in Chinese. I read those and tried to learn the course material by myself. Although there was no perfect substitute for the course textbook in Chinese, it was still helpful. Sometimes I used videos on YouTube or Bilibili (video sharing platform like YouTube but in Chinese usually) as additional resources. When I search online, I use both of my languages. I usually start with English, but when it seems it will take a lot of time for me to understand, then I switch to Chinese.

In addition to searching the course material to help my understanding of the material, I sometimes search for the terms that appear on the question. If I was stuck on some problem, then the main problem was usually that I misunderstood what the question was asking. Although I struggle sometimes because I need to communicate mainly with my second language in the classroom, I see some benefits of being able to use both languages and have figured out how to deal with the challenge. In addition to what I already told you, I know I can ask some friends who speak English and other friends who speak Chinese when I have questions. Also, I use Chinese in my note-taking as well. I use it as an index so that I can quickly check where I need to look because I can notice Chinese easily and read Chinese a lot faster. Another time I use Chinese is for the definitions. I write some definitions or some keywords in Chinese so that I can remember them better. I switch between the two languages... I also write some memos or how I feel in Chinese, such as “don’t fall asleep, you can do it!” “why is it so hard?” or “Confused, review after the class,” so that I can focus more on the class and encourage myself.

Although I have been figuring out how to survive in mathematics classes, COVID-19 added another challenge. Because of COVID, all of my mathematics courses were changed to online, which led professors to explain mathematics lectures on zoom and write them on a sheet of paper. Compared to when they are writing on the board and explaining in front of physical students, they wrote a lot faster as they did not need to write it as big as they did on the board. Also, for some reason, they spoke faster and somehow it felt to me that they were reading the book rather than explaining things to us. I sometimes could not write everything in my notes and could not completely understand what they were explaining. Also, the courses did not have a lot of groupwork during the class time, so I could not even ask questions to peers during the groupwork. So, I tended to review the videos instead of going to the synchronous class because I could rewind and stop whenever I wanted to. ...

So far, I told you a lot of the challenges that I experienced. But, all of these challenges neither discouraged me from studying mathematics nor led me to lose my confidence. I think my challenges in mathematics courses related to language mean that I just need more time than native English speakers, but they do not mean that I am not good at mathematics. ... I think I just need to take more steps moving between the three languages, Mathematics, English, and Chinese. I think mathematics would have been hard even if I studied it in Chinese, but mathematics is charming so I would work hard anyway to understand the material. I am confident that I will definitely learn well if I have enough time (although time just becomes an issue).

Discussion

Jia’s experience is one possible shape of many different experiences that multilingual international students have. This study documented how one multilingual student uses her multiple languages in various mathematical contexts, such as doing homework, taking class, or participating in groupwork. The narrative shows that it can be challenging for multilingual international students to participate in groupwork because the situation is not easy to use multiple languages to take advantage of multiple languages. Jia could use Chinese in various ways in other contexts, such as listening to lectures, taking notes, or doing homework. However, it was hard to use Chinese when working in groups, especially when she was with all native English speakers who could not speak Chinese (Hwang et al., 2022).

Jia’s challenge in groupwork as a multilingual has significance, considering the emphasis on active learning in collegiate mathematics education, which is often connected to equitable learning for all (Freeman et al., 2014; Johnson et al., 2020; Prince, 2004). I am not suggesting

that groupwork harms students but arguing that mathematics educators should be aware of possible challenges students can face. Although Jia attributed her challenging experiences during groupwork to herself, I claim we should focus on external reasons for her actions. Jia said that when she was in a group with at least one other familiar student, usually Chinese, she felt more comfortable sharing her thoughts, which has been found in existing research (Takeuchi, 2016). While she felt connected to having a peer from the same culture, she mentioned that she felt excluded when other groupmates were having conversations about their lives outside the classroom. Given that sometimes conversations that are not relevant to course material create changes in power dynamics between students (Esmonde & Langer-Osuna, 2013), not being able to join small talk because of cultural and linguistic differences can influence the power dynamics in the classroom, which connects to language as stratified and stratifying in mathematics classrooms (Barwell, 2018).

Further, I suggest reflecting on whether people are indirectly implying the notion that students should use English in the classroom and whether multilingual students are discouraged from using their other languages. In her interview, Jia noted that she asked a question to a Chinese teaching assistant, but he responded in English, which Jia thought might be his job. However, I question why the teaching assistant felt he needed to answer in Chinese even though both he and Jia probably knew that their conversation would be clearer and more efficient when they spoke in Chinese. This decision again might have come from the notion that because English is the LOI, it should be more valued than other languages (Barwell, 2018). English is the most reliable common language in U.S. classrooms, making it a good resource to use, but it does not mean other languages should be devalued. Instructors should be aware of and value different ways of communication among students and between instructors and students. This is not to develop “otherness” but for students to use all the assets that they have for their learning.

The current study calls for attention from mathematics educators on how instructors can help multilingual international students utilize the multiple languages that they have. For example, this finding implies that mathematics instructors need to think about how to form a group when they compose a group. In addition, from Jia’s narrative, I also found that she used written discourse as an important source of learning, either when she communicated with her groupmates or when she was learning materials. Jia implied that writing on the board could serve as a visual recording and also slow the pace of the instructor’s lecture, which provides room for all students to think about the materials.

In this paper, I introduced Jia’s perspective as one of the numerous experiences of multilingual international students in mathematics classrooms. However, mathematics educators need to consider how multilingual international students are positioned or viewed in the classroom. In the larger study for which this data was originally collected, our research team has seen some participants describe “linguistic barriers” with international students, which might indirectly imply how general students consider international students. As classrooms in the U.S. are becoming more diverse, I believe how to deal with the perpetuated notion that multilingual international students have “linguistic barriers” in society is an important aspect to consider when mathematics educators teach students.

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References

- Barwell, R. (2018). From language as a resource to sources of meaning in multilingual mathematics classrooms. *Journal of Mathematical Behavior*, 50(August 2017), 155–168. <https://doi.org/10.1016/j.jmathb.2018.02.007>
- Barwell, R., Barton, B., & Setati, M. (2007). Multilingual issues in mathematics education: Introduction. *Educational Studies in Mathematics*, 64(2), 113–119. <https://doi.org/10.1007/s10649-006-9065-x>
- Brenner, M. E. (1998). Development of mathematical communication in problem solving groups by language minority students. *Bilingual Research Journal*, 22(2–4), 149–174. <https://doi.org/10.1080/15235882.1998.10162720>
- Campbell, A. E., Davis, G. E., & Adams, V. M. (2007). Cognitive demands and second-language learners: a framework for analyzing mathematics instructional contexts. *Mathematical Thinking and Learning*, 9(1), 3–30. <https://doi.org/10.1080/10986060709336603>
- Esmonde, I., & Langer-Osuna, J. M. (2013). Power in numbers: Student participation in mathematical discussions in heterogeneous spaces. *Journal for Research in Mathematics Education*, 44(1), 288–315. <https://doi.org/10.5951/jresmetheduc.44.1.0288>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410–8415. <https://doi.org/10.1073/pnas.1319030111>
- Hwang, J., Castle, S. D., & Karunakaran, S. S. (2022). One is the loneliest number: Groupwork within linguistically diverse classrooms. *PRIMUS*. <https://doi.org/10.1080/10511970.2021.2019149>
- Johnson, E., Andrews-Larson, C., Keene, K., Melhuish, K., Keller, R., & Fortune, N. (2020). Inquiry and gender inequity in the undergraduate mathematics classroom. *Journal for Research in Mathematics Education*, 51(4), 504–516. <https://doi.org/10.5951/jresmetheduc-2020-0043>
- Macintyre, P. D., Dornyei, Z., Clément, R., & Noels, K. A. (1998). Conceptualizing willingness to communicate in a L2: A situational model of L2 confidence and affiliation. *Modern Language Journal*, 82(4), 545–562. <https://doi.org/10.1111/j.1540-4781.1998.tb05543.x>
- Meyer, M., Prediger, S., César, M., & Norén, E. (2016). Making use of multiple (non-shared) first languages: State of and need for research and development in the European language context. In *Mathematics education and language diversity* (pp. 47–66). Springer, Cham.
- Moschkovich, J. (2002). A situated and sociocultural perspective on bilingual mathematics learners. *Mathematical Thinking and Learning*, 4(2–3), 189–212. https://doi.org/10.1207/s15327833mtl04023_5
- Neville-Barton, P., & Barton, B. (2005). The relationship between English language and mathematics learning for non-native speakers. *Teaching and Learning Research Initiative Final Report*).
- Planas, N., & Setati, M. (2009). Bilingual students using their languages in the learning of mathematics. *Mathematics Education Research Journal*, 21(3), 36–59. <https://doi.org/10.1007/BF03217552>
- Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223–232. <https://doi.org/10.1002/j.2168-9830.2004.tb00809.x>
- Schleppegrell, M. J. (2007). The linguistic challenges of mathematics teaching and learning: A

- research review. *Reading & Writing Quarterly*, 23(2), 139–259.
<https://doi.org/10.1080/10573560601158461> To
- Sfard, A. (2008). *Thinking as communicating: Human development, the growth of discourses, and mathematizing*. Cambridge university press.
- Takeuchi, M. A. (2016). Friendships and group work in linguistically diverse mathematics classrooms: Opportunities to learn for English language learners. *Journal of the Learning Sciences*, 25(3), 411–437. <https://doi.org/10.1080/10508406.2016.1169422>