International Journal of Assessment Tools in Education
2024, Vol. 11, No. 4, 787–803
https://doi.org/10.21449/ijate.1529210
journal homepage: https://dergipark.org.tr/en/pub/ijate
Research Article

Examining the use of bilingual accommodations in digital math assessments: User perceptions

Alexis A. Lopez[1*]

[1]660 Rosedale Road, Princeton, NJ 08541, U.S.A.

ARTICLE HISTORY

Received: Aug. 07, 2024

Accepted: Oct. 15, 2024

Keywords:

Bilingual accommodations,
Digital math assessments,
Multilingual learners,
Linguistic repertoire,
Language modalities.

Abstract: Digital math assessments with bilingual accommodations allow multilingual learners to use their entire linguistic repertoire to showcase their knowledge and skills. The bilingual accommodations, which include tools like language translation and audio prompts in both English and Spanish, are designed to be adaptable, giving multilingual learners the freedom to view or listen to the items in either language and to write or say their responses in either language or a combination of both. This study examined how 56 middle school emergent bilingual learners used these bilingual accommodations and explored the perceptions of teachers and students regarding these accommodations. This study provides evidence regarding using bilingual accommodation in math assessments for middle school emergent multilingual learners. The results showed how students used their full linguistic repertoire and language modalities to showcase their math knowledge and skills. Both teachers and students reported having positive perceptions of the bilingual accommodations, reinforcing its responsiveness to different learners' needs and preferences.

1. INTRODUCTION

Most current academic content assessments (e.g., math, science) reflect a monolingual view of language and tend to ignore the complex discursive practices used by multilingual speakers (Ascenzi-Moreno et al., 2023; López et al., 2017; Shohamy, 2011). From a monolingual perspective, languages are treated as separate entities and not as a unified system that utilizes the resources of all the languages. Consequently, academic content assessments that reflect a monolingual perspective expect all students to use one language, even if they have multiple languages in their repertoires. However, it is essential to recognize that multilingual learners, when given the opportunity to utilize their entire linguistic repertoire, have the potential to excel in these assessments. Some scholars have pointed out the need to improve existing academic content assessments and develop new ones sensitive to multilingual learners' heterogeneous practices (e.g., García, 2009; López et al., 2017; Otheguy et al., 2019; Sanchez et al., 2013).

Math assessments with bilingual supports utilize the best practices of today's classroom, treating multiple languages as a single, dynamic, unified system. Math assessments conceived in this light allow multilingual learners to utilize their linguistic repertoire more fully by

*CONTACT: Alexis A. LOPEZ alopez@ets.org 660 Rosedale Road, Princeton, NJ 08541, U.S.A.

e-ISSN: 2148-7456

interchangeably moving back and forth from one language to another whenever needed. By doing so, multilingual learners could meaningfully demonstrate their math knowledge and skills during their test-taking experience. It is crucial to note that multilingual learners are unfairly disadvantaged when they are not permitted to draw upon their diverse linguistic repertoire. This is a challenge that needs to be addressed urgently. Consequently, assessments should be designed to value this linguistic diversity and provide multilingual learners with opportunities to demonstrate their knowledge and skills in ways that align with their strengths and preferences and reflect how multilingual learners utilize multiple languages in their daily lives (Ascenzi-Moreno et al., 2023; Paradis et al., 2010).

2. BACKGROUND

2.1. Accommodations in Content Assessments

To address language challenges in standardized content assessments, educators often use accommodations, which are supports provided during the assessment to help emerging multilingual learners. The goal of accommodations in content assessments is to make the assessment content accessible to all students and is intended to increase the validity of the interpretations of what these learners know and can do in a content area (Abedi, 2014; Roohr & Sireci, 2017). Assessment accommodations can include linguistic modifications, which are changes made to the language of the assessment to make it more understandable for the learner, extended time, and alternative response formats (Abedi et al., 2004; Rios et al., 2020). Typically, schools in the United States (U.S.) offer digital assessments with built-in accommodations for these learners, although accommodations are only available to students with identified needs, as determined by educators based on the student's language proficiency and other factors (Rios et al., 2020).

Despite the widespread use of assessment accommodations for emerging multilingual learners, their effectiveness remains unclear (Rios et al., 2020). It is important to highlight, however, that most of these studies have focused on how accommodations influence changes in test scores rather than their overall impact on accessibility (Li & Suen, 2012; Rios et al., 2020; Wolf et al., 2012). Several meta-analyses have shown only small improvements in test scores (Gezer et al., 2023; Kieffer et al., 2009; Li & Suen, 2012; Pennock-Roman & Rivera, 2011; Rios et al., 2020). Nonetheless, many studies have shown that the most effective accommodations in making the assessment linguistically accessible to emergent multilingual learners are language-based accommodations such as using dictionaries, pop-up glossaries, read-alouds, and native language versions of the assessment (Abedi, 2014). Similarly, a few studies have indicated that digital accommodations show promise and could be a significant part of the future of assessment accommodations (e.g., Roohr & Sireci, 2017; Wolf et al., 2021). Some accommodations, such as simplifying language or using glossaries, have shown positive results (Abedi & Lord, 2001; Pennock-Roman & Rivera, 2011). However, other accommodations, like dual language testing or translation, have produced inconsistent findings or lack sufficient research (Pennock-Roman & Rivera, 2011; Rios et al., 2020). This highlights the urgent need for more in-depth research on assessment accommodations to ensure the best outcomes for emerging multilingual learners.

There is growing support for individualized, research-based accommodations and improved teaching methods to help emerging multilingual learners succeed in content assessments (Koran & Kopriva, 2017; Roschmann et al., 2021). Among the challenges that exist in using assessment accommodations include proper implementation (Abedi et al., 2004; Wolf et al., 2012) and the need for tailored approaches based on individual student needs (Bartlett, 2021). To improve assessment validity, researchers recommend developing accommodations that consider students' linguistic needs (Liu, 2023), examining the impact of score interpretation on assessments with accommodations (Iliescu & Greiff, 2022), and investigating the role of academic language skills in content assessments (Kieffer et al., 2009). This research is crucial

in ensuring the best outcomes for emerging multilingual learners and underscores the value of continued research on accommodations in content assessments. The potential of individualized, research-based accommodations is promising and offers hope for improving content assessments for emergent multilingual learners.

2.2. Bilingual Assessment Accommodations

Bilingual accommodations in math assessments can support emergent multilingual learners by allowing students to engage in translanguaging (Lopez et al., 2017). Translanguaging refers to "the deployment of a speaker's full linguistic repertoire without regard for watchful adherence to the socially and politically defined boundaries of named languages" (Otheguy et al., 2015, p. 283). Here, 'named languages' refer to social categories such as English or Spanish (Otheguy et al., 2015). However, the named languages are presented separately when using bilingual supports on a digital math assessment (Lopez et al., 2017).

As a result, a digital math assessment with bilingual accommodations can be seen as an assessment that empowers emergent multilingual learners to utilize their entire linguistic repertoire and language modes to showcase their math knowledge and skills (Lopez et al., 2017). Their linguistic repertoire encompasses standard and vernacular language varieties (Sayer, 2013). The goal is to foster linguistically adaptive bilingual practices within a single assessment context (Shohamy, 2011) and allow students to utilize different semiotic resources, enabling them to perform in writing or orally (Li, 2011) to demonstrate what they know and can do. The items are in multiple languages (e.g., English and Spanish). However, it is the students who have the autonomy to select the named language and the language mode they prefer to use to demonstrate their math knowledge and skills (Lopez et al., 2017).

Several bilingual accommodations have been documented to effectively reduce the score gap between emergent multilingual learners and non-multilingual learners attributed to emergent multilingual learners' limited proficiency in English (Francis et al., 2006). Bilingual accommodations include bilingual test forms, pop-up bilingual glossaries, reading aloud the directions and items in English and the home language, and allowing students to respond in the home language (Abedi, 2009; Pennock-Roman & Rivera, 2011). Although test translation is commonly used as an accommodation to support emergent multilingual learners, not all of them may benefit from this type of support because their language and literacy proficiencies in English and their home language vary tremendously (Smarter Balanced Assessment Consortium, 2012; Solano-Flores, 2008). Thus, it is vital for educators and policymakers to provide bilingual accommodations that meet the specific needs of emergent multilingual learners (Koran & Kopriva, 2017). To enable the agency of emergent multilingual learners and empower them to select which bilingual accommodation they want or need to use, these accommodations should always be available to the students (Lopez et al., 2017).

The evidence on the impact of bilingual accommodations in reducing the achievement gap between multilingual learners with emergent English skills and native English speakers is inconclusive. However, there is support for using bilingual accommodations to make content assessments more equitable and unbiased for multilingual learners (Goodrich et al., 2021; López et al., 2015). Bilingual accommodations have also been found to be effective in helping multilingual learners access the content of assessment items (Abedi, 2021; Roschmann et al., 2021). Therefore, it is important to continue providing empirical evidence that bilingual accommodations do not threaten the validity of content assessments and make them accessible for multilingual learners.

3. METHOD

3.1. The Purpose of the Study

I used a concurrent mixed methods approach where quantitative and qualitative data were combined to examine the use of bilingual accommodations on digital content assessments (e.g.,

math, science). To focalize the study, I selected a digital math assessment to measure the math knowledge of middle school multilingual learners with emerging English skills. I examined which accommodations the students used and how often they used them and investigated teachers' and students' perceptions about using bilingual accommodations. The findings of this study can be directly applied to improve the learning experience of these students, making the research highly relevant and helpful. The following highly relevant research questions guided this study:

1. How did emergent multilingual learners use the bilingual accommodations on a digital math assessment?
2. What perceptions did emergent multilingual learners have of the bilingual accommodations' usefulness in measuring their math knowledge?
3. What perceptions did middle school math teachers have of the bilingual accommodations' usefulness in measuring students' math knowledge?

3.2. The Digital Math Assessment

The digital math assessment used in this study was developed for research purposes only, and the performance on the assessment did not impact the student's grades or standing in their math classes. The assessment aimed to measure students' knowledge of ratios and proportional relationships as described by the U.S. Grade 6 Common Core State Standards for Mathematical Practice (CCSSO, 2010). The digital math assessment was developed using an evidence-centered design (ECD) framework (Mislevy et al., 2003) to ensure its validity from the outset (Kobrin, 2022). Moreover, two math teachers independently reviewed all the items to evaluate the relevance and representativeness of the content domain. The two math teachers also provided suggestions for improving the items, ensuring the quality of the digital math assessment tool. The items were first developed in English and then translated into Spanish. Two bilingual math teachers reviewed the translated items to evaluate the quality and accuracy of the translated items and to ensure both language versions measured the same construct at the same difficulty level.

The math assessment was delivered on a digital platform and contained nine items with bilingual accommodations, including 13 multiple-choice questions and three constructed-response questions. The constructed-response questions had two parts. Part A included number entry questions and Part B included a constructed-response question. This student-centered approach ensured that the assessment was designed with the best interests of the students in mind, allowing them to demonstrate their knowledge in the most effective way. Of a possible score of 19, the scores of all 56 participants ranged from 2 to 15, with a mean of 4.7. The standard deviation was $SD = 3.02$. Cronbach's alpha reliability estimate for the multiple-choice questions was .81, indicating fair consistency of measurement across individual items. The inter-rater reliability of the scoring of the constructed response questions was high, as indicated by an exact agreement of 94% and a Kappa index of 87%. The standard error of measurement was .403.

To allow the students to use their entire linguistic repertoire and language modes, several comprehensive bilingual accommodations were added. These accommodations were always available so students could use them at any given time, if needed. Initially, the students saw the items in English, but they could also see them in Spanish by clicking on a button; they could also toggle back and forth between language tabs at any time (bilingual accommodation 1). For constructed-response questions, students could write their responses in either language, using any dialect, or a combination of both (bilingual accommodation 2). Alternatively, students could also record their responses in either language or a combination of both (bilingual accommodation 3). A few non-mathematical-related words were highlighted in the English or Spanish tab. If students clicked on the highlighted words, they saw a pop-up glossary with synonyms for these words to account for dialect variation (bilingual accommodation 4). This

support did not apply to math-related terminology, which was construct-relevant. The words in the English version were selected based on how critical they were to understand the question. The words in the Spanish version were selected based on how different they were in terms of variety or region. For example, the word "plátano" is also known as "banana," "banano," "cambur" and "guineo" in different Spanish varieties or different regions in Latin America. Thus, we highlighted the word "plátano" in Item 8 and added the other expressions in the pop-up glossary. Finally, students could click on an avatar's picture to listen to someone read aloud the directions and the questions in English and Spanish, depending on the language tab they select (bilingual accommodation 5). This comprehensive approach ensures that the assessment is inclusive and supportive of all students, regardless of their linguistic background.

3.3. Participants

For this study, I selected schools using a combination of purposive and convenience sampling. I specifically focused on recruiting schools with a large number of Spanish-English bilingual students. The schools were selected from a pool of institutions that had participated in previous studies. I chose two institutions because they were willing to participate and easily accessible. The use of purposive and convenience sampling was suitable for this exploratory research study, as it helped me gather initial insights about how multilingual learners used bilingual accommodations to complete the items. The study was conducted with 56 students from two schools in two U.S. states, Oregon and Texas – 28 from each state: 11 sixth graders, 36 seventh graders, and 9 eighth graders. The sample was evenly divided between males and females (30 male students, 53.6%). Their age ranged between 11 and 14 years of age, and they spoke English (3 students, 5.4%), Spanish (24 students, 42.9%), or both languages (29 students, 51.8%) at home. Most students (39 students, 69.6%) were born in the U.S. and began attending school in the U.S. either in pre-kindergarten (22 students, 39.3%) or kindergarten (17 students, 30.4%). Of the students who reported being born outside of the U.S., all but one reported being born in Mexico. The teachers rated most of the students' math knowledge as low (40 low, 15 average, 0 high). The students' levels of English language proficiency varied, though all the students were categorized as English learners by their teachers (22 low, 11 average, 23 high). Additionally, 13 middle school math teachers were recruited for a focus group interview. Two focus group interview meetings were scheduled, one with seven teachers (four female teachers, three male teachers) and the other with six (four female teachers, two male teachers). The teachers included in this study met the following criteria: 1) had at least five years of experience teaching emergent multilingual learners, and 2) had at least ten emergent Spanish-speaking bilingual learners in any of their math classes. These teachers were recruited from a pool of teachers who had participated in previous studies in the last five years and were willing to participate in the study.

3.4. Procedures

A week before the digital math assessment with bilingual accommodations, teachers were tasked with completing a student background questionnaire. This comprehensive tool was specifically designed to gather detailed information about the participants, such as their age, gender, grade, length of time in the United States, languages spoken at home, and scores on state English language proficiency and math assessments. Additionally, teachers were asked to rate their students' English language and math skills as high, average, and low. These ratings were crucial, as they were based on the students' scores on the annual state-wide English language proficiency summative assessment taken the previous school year, or for new students, on their scores on the initial English language identification assessment taken at the beginning of the current school year. The teachers' judgments on their students' math abilities were based on the students' grades in their math class.

Prior to the digital math assessment, students were actively involved in the process. They filled out an online background questionnaire, providing additional information about their language

and educational background. Then, they took the assessment with bilingual accommodations. The assessment platform automatically recorded their responses, the time they spent on each item, and the number of times they used dual language supports, ensuring the data's accuracy and reliability.

Next, students completed an online questionnaire at the end of the study to gather feedback on their perceptions of the items with dual language. The survey included 10 questions. The first five questions used a 3-point Likert scale ranging from 1 = did not like to 3 = liked a lot to measure how much they liked each bilingual support. The last five questions used a 3-point Likert scale ranging from 1 = not useful to 3 = very useful to rate the perceived usefulness of each bilingual support. Finally, to gather more in-depth insights, two focus group interview meetings with the math teachers were conducted. These meetings were significant as they provided a platform for the teachers to share their experiences in supporting emergent multilingual learners in classroom assessments and to discuss their perceptions of each of the bilingual accommodations. Two focus group interview meetings were scheduled, one with seven teachers and the other with six. Each meeting was audio-recorded and lasted approximately 90 minutes.

3.5. Data Analysis

Each student log file (the file generated with each click the student made) was analyzed to determine how the student used the accommodations (research question 1). Frequencies of the times students used each accommodation in English and Spanish were calculated. The students' surveys were analyzed by calculating the frequencies of the ratings on perceptions and usefulness (research question 2). Finally, two researchers worked independently to understand how the math teachers perceived the bilingual accommodations (research question 3), carefully analyzing the two focus group transcripts by identifying key themes and patterns in the participants' responses. This analysis involved multiple rounds of coding and review by two researchers to ensure reliability. The researchers carefully categorized interview sections based on their content (e.g., current practices, perceptions, and recommendations) and then closely examined these categories to find recurring themes (e.g., implementing accommodations in the classroom, usefulness of accommodations, challenges in implementing accommodations). The researchers compared their findings to ensure consistency and resolved disagreements through open discussion. Ultimately, the two researchers identified critical themes related to how teachers currently use accommodations in their classrooms, what they like about the accommodations, what they do not like about them, and other ways to support multilingual learners. The resulting themes revealed how educators used bilingual supports in their classrooms and how helpful each bilingual accommodation in the digital assessment was.

4. FINDINGS

4.1. Use of Bilingual Accommodations (Research Question 1)

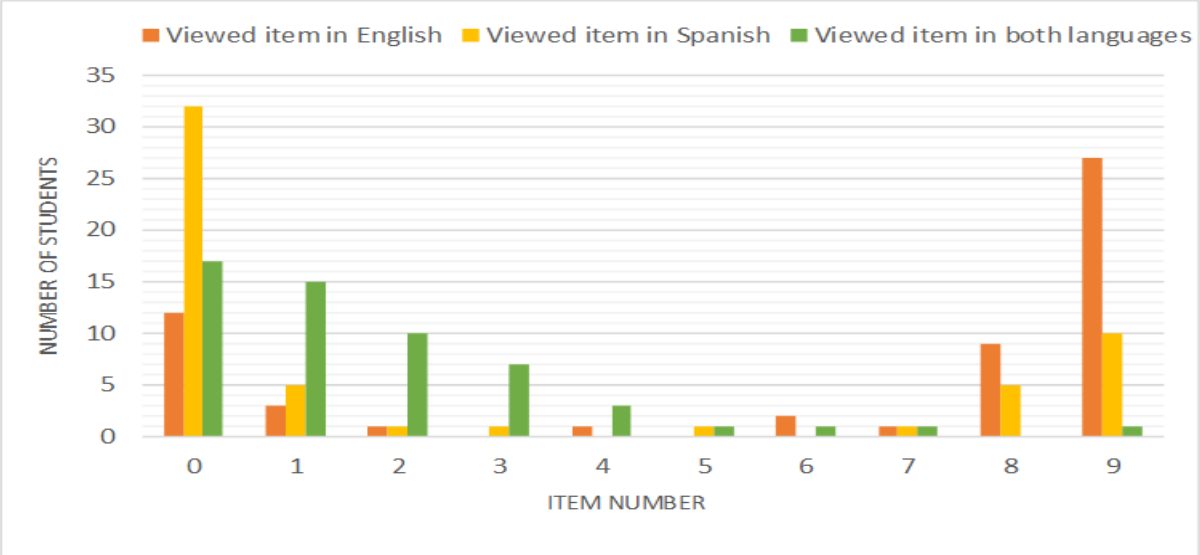
Overall, the students made comprehensive use of the bilingual accommodations, utilizing them frequently. It is noteworthy that all the students made use of the available accommodations at least once, with eleven students using all the available options. Eight students exclusively used the accommodations in English, while six students opted for the Spanish-only accommodations. A significant number of forty-two students utilized the accommodations in both languages. In the following sections, I provide a detailed breakdown of how students utilized each available accommodation.

4.1.1. *Language use*

Students actively participated in the study, using both English and Spanish to answer the items. While most completed the items in English (see Figure 1), it's important to note that 44 students answered at least one of the items in English, with 32 answering all in English. On average, these students answered 7.9 items in English. Conversely, 24 students answered at least one of

the items in Spanish, with 12 answering all in Spanish. On average, 6.5 items were answered in Spanish. Twenty-nine students demonstrated their active involvement by toggling back and forth between English and Spanish in at least one item. One student showed exceptional engagement by switching languages in all the items. In total, 12 students answered items in both languages. Seven answered most of the items in English, with an average of 6.2 items answered in English. Contrarily, five students answered most of the items in Spanish, with an average of 2.8 items answered in Spanish.

Figure 1. *Frequency graphs of language used to answer the items.*



When it comes to the language used in the constructed-response items, it is worth noting the efforts of most students to respond in English, even when their proficiency was low (see Table 1). Thirty-three students responded to all the constructed-response items in English, 13 only in Spanish, and two using only symbols and numbers (e.g., math sentences). Three students showcased their individuality through their responses. Two of them answered some questions in English, and some used symbols and numbers. One student answered two questions in English and one in Spanish. In general, students did not mix languages in their responses, with only one student doing so for one question.

Table 1. *Type of response in each constructed-response item.*

Type of response	Q7	Q8	Q9	Total
In English	31	32	30	93
In Spanish	12	10	11	33
In both English and Spanish	0	1	0	1
Only symbols and numbers	3	3	2	8
No response	10	10	13	33

Some students demonstrated resourcefulness in their use of translingual practices when responding to the constructed-response items in English. Translingual practices refer to the "ability to merge different language resources in situated interactions for new meaning construction" (Canagarajah, 2013, pp. 1–2). A few students wrote responses such as, "i oli ad them all up" [I only added them all up], "I ONLI POT 4 BOES" [I only put four boxes] and "i nhou because i didet on mi paper" [I know because I did it on my paper].

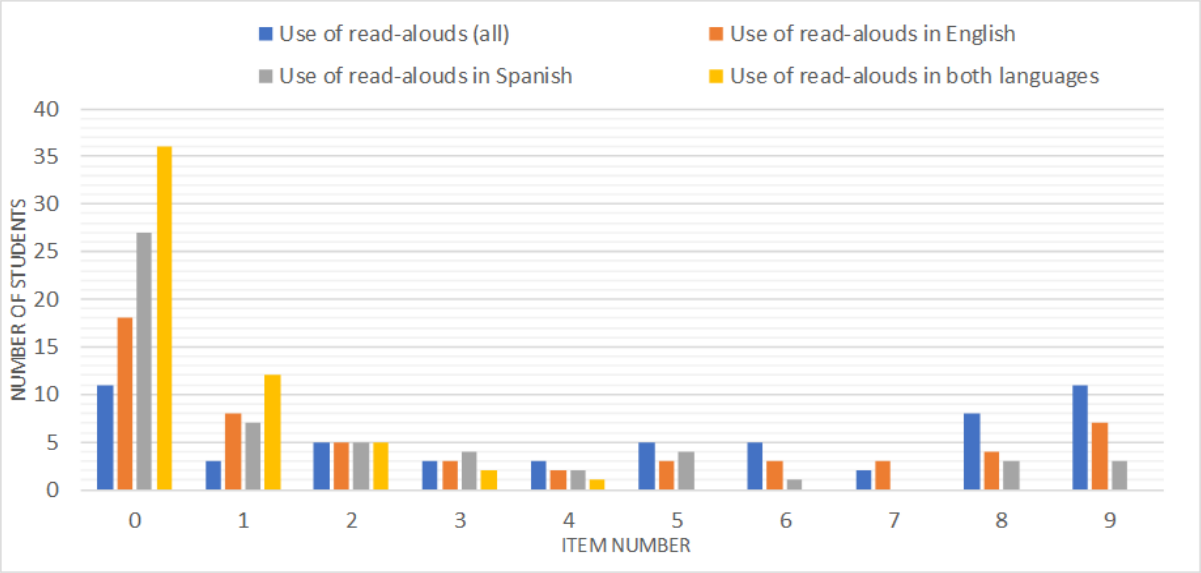
4.1.2. *Language modality in constructed-response items*

When it comes to the language mode used to answer the three constructed-response questions, it's worth noting that most participants (except for three students) preferred to type their responses rather than record them. These three students recorded all their responses in English. However, it is important to note that 14 students initially attempted to record their responses but found it challenging and switched to providing a written response. This adaptability suggests that for some, writing their responses was easier than recording them. The majority's preference for typing may indicate a higher comfort level in typing responses over recording them.

4.1.3. *Read alouds*

Figure 2 provides information about the number of times students listened to someone reading aloud the questions to them. Students used the read-aloud accommodation frequently; 46 students used it at least once; 11 students used it in all the items. On average, students used the read-aloud accommodation in six items. The read-alouds were used more frequently in English; 38 students listened to the items in English at least once, while 27 students did the same in Spanish. Altogether, students used the read-aloud in English for five of the nine items, while the read-aloud in Spanish was used for four. Notably, 20 students (35.7%) listened to at least one of the items in both English and Spanish, which was an unexpected finding. Overall, these students listened to at least one item in English and Spanish.

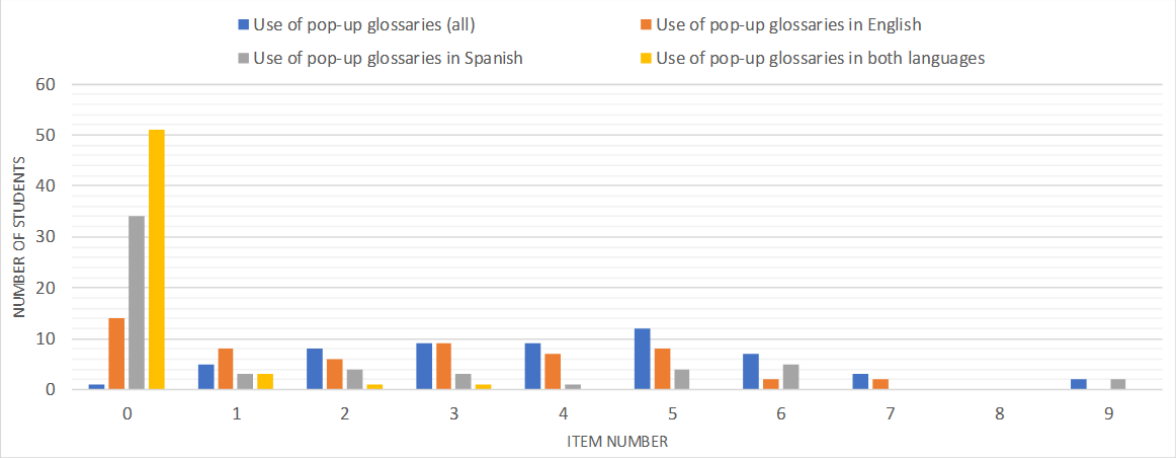
Figure 2. *Number of items in which students listened to the questions by language.*



4.1.4. *Pop-up glossaries*

Students used the pop-up glossaries frequently (see Figure 3). Only one student did not use this accommodation. On average, students used the pop-up glossaries in four items. When categorized by language, I found that students used the pop-up glossary more frequently in English. Forty-two students used it at least once in English; two of them used this accommodation in seven items. Conversely, 22 students used this accommodation at least once in Spanish; two used it in all the items. Only five students used this accommodation in English and Spanish at least once, demonstrating their adaptability and diverse usage patterns.

Figure 3. *Number of items in which students used the pop-up glossaries (by language).*



4.2. Students' Perceptions (Research question 2)

When asked to share their thoughts, the students expressed their appreciation for the five bilingual accommodations. Their feedback revealed a general liking for all the available options (see Figure 4). They particularly enjoyed the translations and the read-alouds. Even the least favored accommodations, such as recording responses in constructed-response items and the pop-up glossaries, were still helpful (see Figure 5). The students' appreciation for these accommodations was further confirmed when they reported that they all clarified what the questions were asking them to do and were very helpful when answering them. According to their feedback, the most beneficial bilingual accommodation is viewing the items in both English and Spanish (translation accommodation).

Figure 4. *Students' perceptions of the bilingual accommodations (%).*

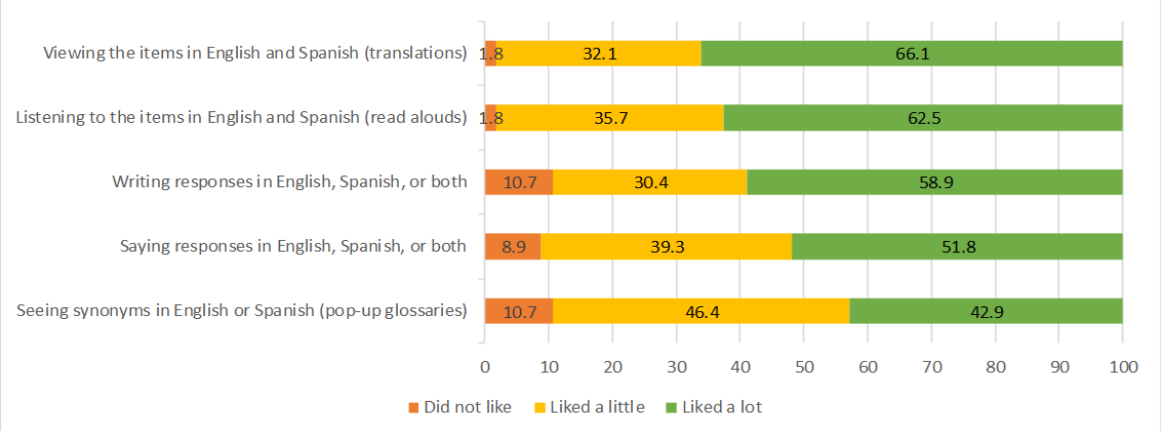
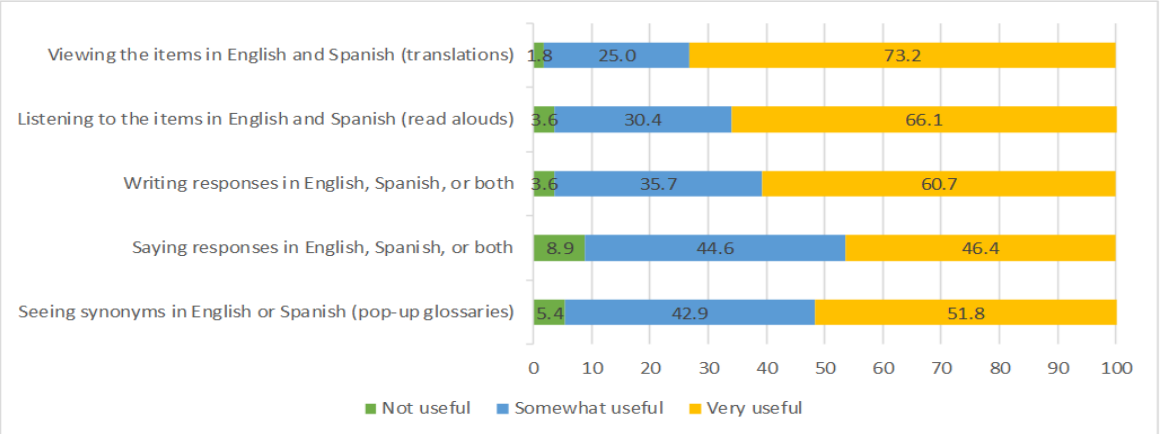


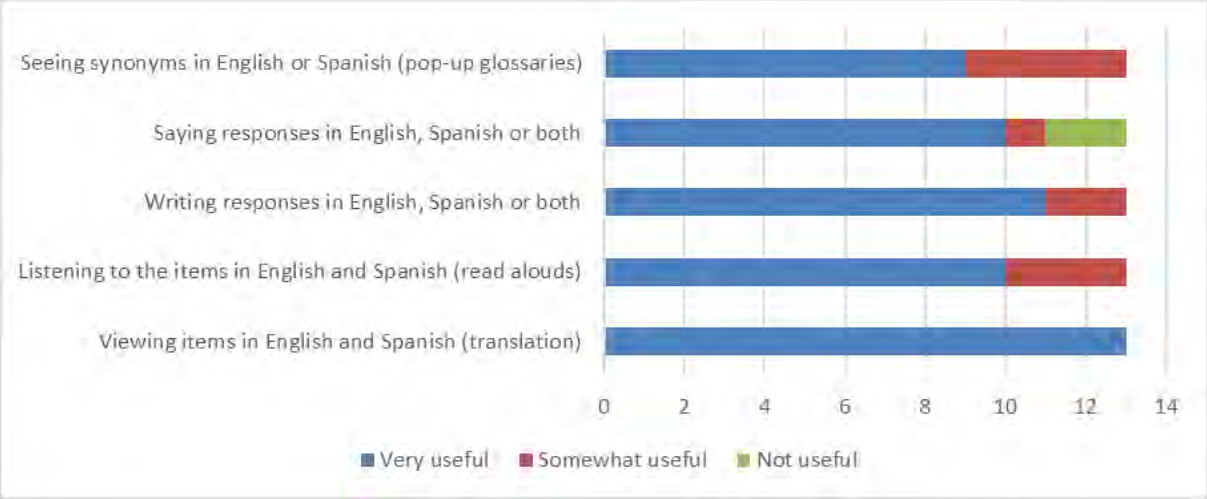
Figure 5. *Students' perceptions of the usefulness of the bilingual accommodations (%).*



4.3. Teachers' Perceptions (Research Question 3)

In general, the math teachers found all the bilingual accommodations beneficial. They felt that these accommodations are similar to how they support emergent multilingual learners in their classrooms, allowing students to validly demonstrate their math knowledge and skills. Figure 6 indicates the number of teachers who found each bilingual accommodation useful. One teacher expressed this alignment: "I give my assessments in both English and Spanish. Sometimes I use online translators and sometimes I use fellow teachers who, you know help me translate the questions. But I give it in both English and Spanish" (excerpt focus group 1, female teacher 1).

Figure 6. *Teachers' perceptions of the usefulness of the bilingual accommodations (N = 13).*



Five teachers commented that they usually have students help each other by translating the items, reading aloud the items, or explaining what the items are asking them to do. One of the teachers explained how they have students help each other in classroom assessments: "I'll find another student who speaks Spanish to explain it. I know sometimes it's difficult, because you worry they might help them with the math process. So, I tell them, if you're helping, you can't tell them what to do. Just explain it so they can understand" (excerpt focus group 2, male teacher 2).

Three teachers did not find the '"Say the Response"' accommodation useful because most of their open-ended questions require students to write math expressions or graph the response. They also mentioned that this accommodation is rarely offered in large-scale state math assessments, so they want their students to become comfortable writing their responses. However, the other ten teachers liked this accommodation. One of them stated the following about allowing students to provide oral responses: '"I think it's important to see how well they can explain it, whether in English or Spanish, writing or speaking. Some of my students can't speak English well and can't read or write in Spanish. So, using this accommodation is the only way they can complete the questions"' (excerpt focus group 2, male teacher 1). It's important to note that while this accommodation may not be suitable for all types of questions, it can significantly benefit students who struggle with written expression, allowing them to demonstrate their understanding of mathematical concepts more effectively.

Moreover, the teachers liked the pop-up glossaries but wanted to change how they were implemented. For example, one of the teachers commented, "If you highlight certain words, you're drawing attention to it. Also, they might stumble across other words they don't know, but they're not highlighted. My students raise their hands in class to ask me about tricky words. I like having these teachable moments in class" (excerpt focus group 1, female teacher 2). Another teacher suggested having pop-up glossaries for all the words because "it is difficult to determine which words are problematic for English learners" (excerpt focus group 1, female teacher 2).

The math teachers were also asked to judge whether adding bilingual accommodations would change the construct measured in the digital assessment. All the teachers agreed that the bilingual accommodations do not change the items' construct. Regarding the construct of the item, one teacher explained: "In the question where they have to find the area of a circle, are we assessing something different if they do it in any language or if they read, listen to, write, or say it? They are still finding the area of the circle. It's assessing the same math" (excerpt focus group 1, male teacher 1).

The teachers also highlighted the need for assessments that help emergent multilingual learners overcome language barriers and demonstrate their math knowledge. They all feel an assessment with bilingual accommodations would be instrumental in learning what newly enrolled students know and can do in math and that they would like more accommodations added. For example, four teachers commented that students can use online translators to translate their responses into English if they respond in their home language. Other suggestions included modifying the language of the items to reduce the reading load (9 teachers) and having more visual representations like graphs or number lines (3 teachers).

5. DISCUSSION

First, I delved into the students' utilization of the available bilingual accommodations. As in other studies, I discovered that students employed these accommodations in diverse ways (e.g., López, 2023; López et al., 2019). Notably, some students responded to all the items in a single language (either English or Spanish), while a few seamlessly switched between the two to answer the items. This finding is particularly striking as it demonstrates a high level of bilingual proficiency and the ability to switch languages as per the task at hand. Furthermore, some students opted to use all or some of the available bilingual accommodations, while others chose not to use them at all. Most students utilized the accommodations more frequently when tackling the items in English, indicating their strategic use of the available resources based on their needs. These results echo other studies that show how multilingual learners strategically employ their linguistic resources (e.g., Velasco & García, 2014).

This study also brought to light the creative use of language by some students with emerging English language skills who chose to complete the assessment in English. These students, armed with their emergent English writing skills, tackled the constructed-response questions in a unique way. They deviated from standard written English conventions and produced hybrid responses that incorporated elements from both English and Spanish. In their responses, they used phonemic and phonological features in Spanish to spell some words in English (e.g., “pot” instead of put, “nhou” instead of know, “didet” instead of “did it”). This flexible and inventive language use across linguistic boundaries, often referred to as translingual practices (Canagarajah, 2013), not only underscores their creativity but also their ability to use all their linguistic resources, even if they are not fully developed (Martin-Beltrán, 2014). The concept of translingual practice challenges traditional notions of language boundaries or language separation and emphasizes the fluid, dynamic nature of communication across linguistic and cultural contexts (Canagarajah, 2018).

These findings underscore the importance of expanding scoring to account for translingual responses in academic content assessments for emerging multilingual learners. This approach involves scoring responses regardless of the language or mode used, including mixing or hybridizing the languages. Allowing students to use all their linguistic resources in math assessments, including the use of multiple languages and different modalities (Kusters et al., 2017; Li, 2011), is crucial. In this study, the bilingual accommodations enabled students to use different modalities to interact with and respond to the items. A few students listened to the directions, some in English and some in Spanish. Similarly, a few students also listened to some of the questions, in English or Spanish.

To answer the constructed-response questions, most of the students typed their responses; however, three students used the Say the Response accommodation to record their responses. This diverse use of different bilingual accommodations by the students demonstrates their determination to understand and respond to the items, and to draw on new and complex language practices (García & Li, 2014). Lastly, students used the pop-up glossaries more frequently when viewing the items in English. This suggests that many students preferred to answer the items in English, so it is imperative to provide more accommodations in English. For example, language simplification (e.g., Rivera & Stansfield, 2004), pictorial glossaries (e.g., Turkan et al., 2019), word boxes (e.g., Harmon et al., 2013), or sentence starters/frames (e.g., Donnelly & Roe, 2010).

Second, I also examined how students perceived the available bilingual accommodations. The students positively perceived the bilingual accommodations, even if they did not use them or felt unnecessary. Students liked having this flexibility because the bilingual accommodations are always available and can be used whenever needed. Having assessment accommodations that are always accessible gives emerging multilingual learners 'student agency' (Adie et al., 2018; Emirbayer & Mische, 1998) and enables student choices and actions in digital math assessments. In a way, students are empowered and are more engaged in the assessment because now they have the autonomy to decide if they want to use the bilingual accommodations, when to use them, or which ones to use. One of the main benefits of having increased student agency in assessment includes enhanced student motivation and engagement, which results in students having a more active role in assessment decisions (King et al., 2024).

When it comes to the students' preferences, it was discovered that they favored all the bilingual supports. However, the most popular ones were viewing the items in both English and Spanish and having someone read them aloud. In terms of usefulness, a significant majority of students believed that the bilingual accommodations were instrumental in their understanding and completion of the items. This finding aligns with other studies that have examined the use of assessment accommodations (e.g., López et al., 2019; Wolf et al., 2021). This is a crucial point to highlight, as the primary aim of bilingual accommodations is to enhance the accessibility of the items for emergent multilingual learners (Kieffer et al., 2009; Rios et al., 2020; Wolf et al., 2012). According to the students, these accommodations effectively reduced language barriers, enabling them to better showcase their true math proficiencies.

Finally, this study aimed to explore math teachers' perspectives on the effectiveness of bilingual supports on a digital math assessment. The teachers, in general, found these supports to be beneficial and in line with the supports they offer in their classrooms. This alignment underscores the importance of providing assessment accommodations that students are accustomed to (Rios et al., 2020). Therefore, it is crucial to extend similar supports to emergent multilingual learners in classroom instruction to aid in their academic success.

It is worth noting that teachers discussed the need for assessment accommodations that are tailored to the needs of multilingual learners. Recent research underscores the significance of 'linguistically responsive assessments' for multilingual and diverse learners (e.g., Walker et al., 2023; Yang, 2024). These assessments integrate learners' linguistic and cultural resources, thereby supporting both content learning and language development (Lyon, 2023). 'Linguistically responsive assessments' are those that consider the diverse linguistic backgrounds of students and provide appropriate accommodations to support their learning. A few studies have indicated that multilingual learners perform better on multilingual tasks than on monolingual tasks (e.g., Ascenzi-Moreno, 2018).

5.1. Limitations of the Study

The study was largely limited by the fact that the assessment itself was exploratory, and students' performance had no consequences, making it a no-stakes assessment. This could have affected the students' motivation to perform well, which is associated with lower performance

(Wise & DeMars, 2005). Also, there were some limitations with the available student sample, which was homogeneous. The sample did not vary in mathematical proficiency (e.g., most students exhibited low mathematical proficiency), language background, and home demographics. The lack of variance in mathematical proficiency is a significant limitation that prevented the study from adequately exploring the relationship between performance and the use of bilingual accommodations. Despite these limitations, the study's findings on the use of bilingual supports on digital math assessments for middle school multilingual learners with emergent English skills are valuable and of great importance to the field of bilingual education.

5.2. Implications for Future Research and Practice

There is a pressing need for further research to validate the use of bilingual accommodations on digital math assessments. This study found that students had a positive perception of all available bilingual accommodations. However, it would be intriguing to investigate if there is a relationship between individual student use of each bilingual accommodation and their preferences. There may be patterns in how students use the accommodations and their preferences, based on student characteristics, educational experiences, or item characteristics, that we have yet to explore. For instance, students may be more likely to use specific bilingual accommodations when faced with assessment items with high language complexity. Follow-up studies could examine students' rationale for using specific accommodations using think-aloud protocols, to understand the reasons behind their bilingual accommodation choices.

These studies can also focus on how specific subgroups of multilingual learners use assessment accommodations, such as students who have learned math mostly in English versus those who have learned math mostly in Spanish. Moreover, future studies should also investigate the innovative potential of leveraging artificial intelligence (AI) to personalize assessment accommodations. The use of AI could improve the way we meet the needs of multilingual learners. By determining the needs based on the characteristics of the students or their educational experiences, we can ensure a more tailored, effective, and inclusive approach to assessment accommodations.

6. CONCLUSION

This study provides evidence regarding the use of bilingual accommodation in math assessments for middle school emergent multilingual learners. The students used their full linguistic repertoire to showcase their math knowledge and skills. The bilingual accommodations allowed students to select which language (English, Spanish, or both) they wanted to use to access and understand the items. The bilingual accommodations also allowed the students to select which language they wanted to use to respond to the items and allowed them to use their entire linguistic repertoire to answer the constructed-response questions. In the constructed-response questions, students used English, Spanish, numbers, symbols, or a combination of all these resources to solve the problems and to demonstrate their understanding without being penalized. A few students even used translingual practices to respond to the constructed-response questions. The bilingual accommodations also allowed students to use different language modalities to understand the questions (i.e., view and listen to items in both languages) and to answer the open-ended questions (i.e., say or write their response). This study takes an important first step toward understanding the potential benefits of making use of students' multilingual repertoire in a math assessment. Finally, students and teachers had positive perceptions of the bilingual accommodations and liked that they reduced the language barriers and allowed students to use all their language resources to showcase their math knowledge and skills. Although this study is built around the students' interactions on a particular set of items, the issues raised are likely to be of relevance to other mathematic assessments or other content areas (e.g., science). However, the most significant aspect of this study is its global implications. The prevalence of multilingualism worldwide due to globalization, mobility, and technology (Cenoz & Gorter, 2015) makes the findings from this

study not only relevant but also important for many contexts around the world, underscoring the significance and relevance of the study.

Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the author. **Ethics Committee Number**: The Committee for Prior Review of Research, IRB-FY2023-16.

Orcid

Alexis Lopez https://orcid.org/0000-0002-4616-1091

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