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Considering the Design and Use of Differentiated Activities and Fluency Games to Advance Equity-Based Mathematics Practices

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Abstract

Equity-based practices in mathematics are advanced when educational teachers use formative assessment data and differentiate learners' experiences based on that data. To this end, educational designers can support teachers through the design of high-quality instructional resources that are aligned to mathematics standards, incorporate research-based pedagogies, and provide all learners with access to these experiences. In this article we apply Gutiérrez' (2009) framework for equity-based mathematics practices and formative assessment processes as guideposts for promoting equity in elementary school mathematics classrooms. We then describe and critically examine two vignettes of how the design of instructional activities and associated professional learning experiences can support teachers' use of equity-based practices in their mathematics classrooms. Implications for this work center on the need to embed equity-based practices in the design of instructional resources, the need to provide high quality professional learning opportunities for teachers related to equity-based teaching, and the need to allow teachers to have some autonomy and freedom in how they use instructional resources based on their individual students' needs.

Introduction

Mathematics teachers are charged with effectively meeting the needs of students with disparate backgrounds in their knowledge, skills, and understanding of mathematics concepts that they have previously experienced. In their 2014 position statement on Access and Equity, the National Council of Teachers of Mathematics (NCTM) stated that, "creating, supporting, and sustaining a culture of access and equity requires being responsive to students' backgrounds, experiences, cultural perspectives, traditions, and knowledge when designing and implementing a mathematics program and assessing its effectiveness (p.1)."

Designers must equip teachers with materials and professional learning experiences that are designed to increase access to high-quality mathematics experiences for all learners as well as include scaffolds to support learners based on data. This article will leverage Gutiérrez's (2009,2012) four dimensions of equity-based mathematics teaching to describe two vignettes about the design of curricula resources and professional learning experiences that promoted equity-based teaching in elementary school classrooms. The first vignette focuses on the design of curricula resources focused on a Launch-Explore-

Discuss model and the process of supporting teachers' use of those resources in order to increase teachers' enactment of equity-based mathematics practices. The second vignette focused on the design of professional learning experiences for primary grades teachers and their use of formative assessments and commercially-produced resources in order to enact equity-based mathematics pedagogies.

Framework for Equity

Gutiérrez's (2012) framework for equity in mathematics education involves four dimensions: Access, Achievement, Identity, and Power. Gutiérrez organized those dimensions on two axes. The dominant axis, including Access and Achievement, is defined as "mathematics that reflects the status quo in society, that gets valued in high-stakes testing and credentialing (p. 33)." The critical axis includes the dimensions of Identity and Power. Table 1 describes the framework and the various dimensions.

Table 1: Framework for Equity in Mathematics (Adapted from Gutiérrez, 2012)

Dominant Axis	
Access	The extent to which students have resources to support mathematics learning, such as high-quality teachers, adequate technology and resources in the classroom, a curriculum aligned to national or local standards, and a classroom environment that invites participation from all learners.
Achievement	Students' participation in mathematics classes, their test scores, and their participation in the pipeline of mathematics courses that may lead to careers in mathematics.
Critical Axis	
Identity	The extent to which students see themselves in their curriculum and the mathematics that they do. Additionally, the extent to which mathematics provides students with a broader view of the world.
Power	The extent to which students have a voice in the classroom. This dimension also includes broader issues such as how students use mathematics as a tool to critique society or examine societal issues, and recognizing alternative notions of knowledge.

Gutiérrez argues that these four dimensions come together for students and math educators to exist and succeed in the current mathematics education landscape and push forward to change the current environment. Access to resources is important, but inadequate when considering decades of injustice as it relates to specific demographics and subgroups of children. If equity rests on an equal distribution of supplies and quality mathematics educators alone, it will remain insufficient for achieving our goals. Achievement when defined by standardized tests has a significant negative impact on student outcomes; however, these tests remain gate keepers for full access to higher education and career choices. The identity dimension considers the cultural capital of each student and the recognition of self within society. The power dimension highlights opportunities to rethink mathematics.

Gutiérrez (2009) introduced this framework and expanded on it in 2012; however, two quotes from the 2009 piece guided our analysis. First, "equity is ultimately about the distribution of power—power in the classroom, power in future schooling, power in one's everyday life, and power in a global society (p. 5)" and secondly "being able to name the dimensions helps us move toward highlighting tensions between the dimensions so that we might be more reflective about how we can successfully balance attending to them all (p. 6)." Distribution of power is layered and exists at a micro level between individuals in a relationship to a more macro discussion of our global society. What occurs in the mathematics classroom between teachers and students involves a distribution of power

that can transcend to larger spaces. When examining power distribution in the classroom, Gutiérrez suggests this can be measured by who gets to speak and make decisions. The second quote drives our reflection in the two vignettes presented. Gutiérrez encourages naming the dimensions, identifying tensions that exist between the dominant and critical axis, and reflecting to achieve balance.

Use of Formative Assessment Data to Advance Equity

Student achievement is often at the center of education research studies and Gutiérrez (2009, 2012) includes achievement as one of the four dimensions of the equity framework. Formative assessment advances this achievement goal. Black and Wiliam (1998) discuss formative assessment as a method to design instructional activities that are based on the needs of students. Empirical data indicates that formative assessment is a beneficial practice in developing mathematics understanding for all learners (Hattie, 2009; Wiliam, 2007). It produces an experience where students' feedback is continually used to create instruction that supports learning outcomes (Conderman & Hedin, 2012). Beginning with formative assessment places what students know and understand mathematically as the focal point, and promotes equity (Kalinec-Craig, 2017).

Formative assessment can occur in the classroom in a variety of ways since it is examining mathematical understanding in particular moments as opposed to summative assessments that test students on larger amounts of material. Some examples that researchers support as formative assessment practices are well-constructed tasks, questions, problem-solving interviews, and discussions (Bennett, 2011; Ginsburg, 2009; Pryor & Crossouard, 2008). Note the importance of formative assessments that allow students to share their strategies without a narrow expectation of responses from their instructor.

The process of formative assessment includes multiple integral aspects. These include: 1) collecting formative assessment data, 2) analyzing the data, 3) designing learning experiences, and 4) implementing the learning experiences. We describe each in this section.

First, teachers must find ways to collect student data that is aligned to national or local standards and objectives from learning experiences that are naturally-occurring and not additional tasks that are done only to collect data (Nortvedt & Buchholtz, 2018; Reeves, 2000). Second, teachers need to analyze the data in order to determine students' strengths and concepts where they need more learning opportunities. Third, there is a need for teachers to design future educational experiences for students. Lastly, teachers implement the learning experiences they designed and return back to the first step in the process.

Examples of Designing for Formative Assessment to Advance Equity-based Mathematics Practices

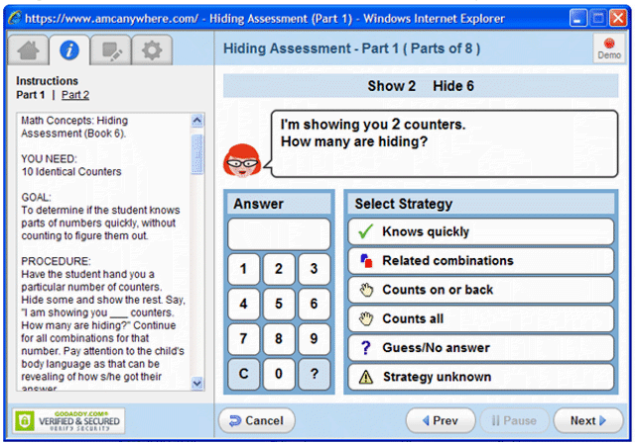
In the following two sections, we provide two vignettes. The first vignette provides descriptions of a three-year funded project focused on supporting teachers' use of formative assessment in school districts with high percentages of students experiencing poverty and whose performance data historically is below the state average on state-wide assessments. The second vignette focuses on the design of mathematics games aimed at improving students' fluency and number sense. In both vignettes, we first provide a description of the designed materials, and then we highlight how the design of both learning experiences and instructional materials contributes to advancing equity-based mathematics practices, using the Gutiérrez framework as a lens for description and reflection.

The APLUS Project: Formative Assessment and Differentiation in Elementary School Mathematics

Overview

As part of the *Assessment Practices to Support Mathematics Learning and Understanding for Students (APLUS)* project, teachers in Kindergarten through Second Grade were provided professional learning about and access to an internet-based formative assessment tool called Assessing Mathematics Concepts (AMC) Anywhere (see Figure 1), as well as instructional activities and materials that were aligned with the assessment tool. The project ran for three years with a new cohort starting each year. The participating districts included three districts around North Carolina that each had high percentages of students experiencing poverty and were each scoring below state averages on mathematics state-wide assessments. These three districts were purposefully selected based on previous partnerships with project leaders as well as their commitment to supporting mathematics experiences for their students that included student-centered activities as well as equity-based instructional practices.

Figure 1 – Screenshot of AMC Anywhere Hiding Assessment



We designed the professional learning around the formative assessment process. Teachers participated in experiences collecting data from children and analyzing specific data sets during workshops. Teachers then spent time during professional learning considering which instructional activities should be used based on data. The datasets analyzed included an individual student report (Figure 2) and an instruction report (Figure 3). In the individual student report (Figure 2), the formative assessment program uses letters to describe students' progress: A for students who are ready to apply their skills during independent activities; P for students who need more teacher-facilitated practice activities; and I for students who need more teacher-led instructional activities. Teacher-led activities are more structured and involve more opportunities for the students to interact with teachers during the activities, while teacher-facilitated activities are student-led with the teacher occasionally asking questions or observing the students. See Richardson (2014) for an overview of the various levels shown in Figure 2.

Figure 2 – Student Progress Report from AMC Anywhere

Hiding Assessment - Part 1: Identifies Missing Parts of Numbers with Models								
Date	3	4	5	6	7	8	9	10
9/6/2018		A	P	I				
11/15/2018		A	P+	P				
1/10/2019			A	I				

The instruction report (Figure 3) provides teachers with data on students as well as a proposed way to sort students based on their specific mathematical needs. In most cases, these categories include the same activities, but recommend teachers to modify the number sizes to decrease or increase rigor.

Figure 3 – Class Instruction Report from AMC Anywhere

Hiding Assessment - Part 1: Identifies Missing Parts of Numbers with Models									
Student	Date	3	4	5	6	7	8	9	10
Working on Parts of 3									
	04/14/2022	I							
	04/21/2022	I	I						
Working on Parts of 5									
	04/25/2022		A	P	I				
Working on Parts of 6									
	03/10/2022			A	P				
	02/16/2022			A	P	N			
	02/16/2022			A	P	P			
	04/21/2022				P+				
Working on Parts of 7									
	04/21/2022			A	A	N			
	04/13/2022			A	A	I			
	04/26/2022					P	I		
Working on Parts of 8									
	04/13/2022				A	A	P	I	
	05/09/2022					A	P+		

The professional learning was designed to include 40 hours of face-to-face workshops during summer workshops, 6 hours of face-to-face workshops during the school year, and 3 online modules. Table 2 describes how the formative assessment process was embedded in the face-to-face professional learning activities. Table 3 describes the aspects of the formative assessment process as it was implemented during the online professional learning activities.

Table 2: Description of Professional Learning Activities

Phase of Formative Assessment Process	Description
Collecting Formative Assessment Data	Teachers collected formative assessment data while: • Watching videos of students completing the assessment • Working with other teachers who played the role of students. Teachers who role played demonstrated various misconceptions in order to allow for ample opportunities to observe varying student behaviors on the assessment • Working with students from a local summer camp
Analyzing Formative Assessment Data	Teachers examined the formative assessment data in the internet-based system by looking at: • Classroom reports that sort and organize all of the students in their class based on student needs • Individual student reports that provide a longitudinal look at student progress
Determining Future Instructional Activities	Teachers determined which instructional activities students should do based on their analysis of the formative assessment data. They used resources including: • State mathematics standards and supporting documents • Instructional materials that accompanied the formative assessments • Curricular resources purchased by their school district
Implementing Future Instructional Activities	Teachers came with data collected after they implemented instructional activities based on their data analysis. They examined: • Data reports from the formative assessment system • Student work samples from activities • Their own experiences that they would share with their colleagues during workshops

Table 3: Overview of Online Professional Development Modules

Time of Year		Activities
Module 1	First two months of the school year	Teachers assess their students using the *AMC Anywhere* system. Teachers design and share their plan for organizing their mathematics instruction to differentiate activities based on data. Teachers collaborate via online discussion boards sharing ideas about instructional activities to use.
Module 2	Middle of the school year	Teachers assess their students using the *AMC Anywhere* system. Teachers design and share their plan for intensive targeted support for a group of their students who require specific differentiation. Teachers collaborate via online discussion boards their successes, barriers to implementation, questions, and progress of their students.
Module 3	Last two months of the school year	Teachers assess their students using the *AMC Anywhere* system. Teachers provide results and updates about their students' growth, the use of the *AMC Anywhere* system and associated instructional materials. Teachers learn about Number Talks, a process for facilitating conversation about number sense, and implement at least one Number Talk in their classroom.

Outcomes

As part of the project, data was collected on multiple outcomes. Among the teachers who participated in professional learning experiences, those that used the formative assessment system and instructional resources at least twice had statistical higher student outcomes than those teachers who used the formative assessment system and materials less than twice (Polly et al., 2018). Further, for teachers who used the formative

assessment system more than twice, students who started farther below grade level expectations grew at a greater rate than those students who started at grade level expectations (Polly et al., 2018).

Teachers reported that they benefited from the embedded supports in the designed instructional activities that gave them guidance on which activities to use based on their students' data (Martin et al., 2016). Teachers also reported that having professional learning experiences to support their use of the designed instructional resources contributed to their high fidelity of enacting the instructional resources (Martin et al., 2016; Polly, 2017).

Equity Framework Reflection for AMC Anywhere

The *AMC Anywhere* assessments and associated instructional materials were aligned well with the Gutiérrez Access and Achievement dimensions, the dominant axis in the Gutiérrez framework (2009, 2012). Focusing on the Achievement dimension, the assessments and instructional resources were aligned to State Standards and focused on developing students' understanding of mathematics concepts. Outcomes from the *Assessment Practices to Support Mathematics Learning and Understanding for Students* project indicated that the use of the formative assessment process, the assessments, and associated instructional materials led to improved student learning outcomes. In accordance with the Access dimension, the activities focused on hands-on mathematics experiences that integrated counting, place value, addition, and subtraction. These hands-on activities that use manipulatives and other representations of numbers are aligned to research on mathematics learning that they help scaffold and support all learners with ways to experience and engage in mathematics activities.

The critical axis of the Gutiérrez framework (2009, 2012) accounts for the dimensions of Identity and Power. Focusing on identity, the *AMC Anywhere* activities include mathematics without context, so it is not easy for students to see themselves in the mathematics activities. The structured nature of the formative assessment also limits how much students draw upon their cultural and linguistic resources, thereby limiting how much the social transformation aspect of the power dimension is reached.

However, students did appear to have increased confidence and see themselves as capable of being successful in mathematics, which aligns to the Identity dimension. Additionally, the identity dimension, noted by Gutiérrez (2012) as the precursor to power, is in part the opportunity to draw from your own resources and reflect on oneself in a learning experience. The AMC tool prompts students to engage in a hands-on experience for the purpose of understanding their strategies, resources, decision making and number sense. The students are not guided or expected to interact in a particular way. The data produced offers insight into the individual student's reasoning. In this way, the student's own voice is guiding instruction, which partially aligns to the power dimension of the critical axis (Buchheister et al., 2019).

Recognizing how each of the four equity dimensions are present pushes us forward in identifying additional ways to make the design of future projects more aligned with aspects of equity-based mathematics teaching. It is clear that the AMC Anywhere formative assessment system and associated instructional materials only aligned partially to the critical axis of the framework. One possible way that these instructional materials can be better used to leverage the *Identity* dimension of the framework involves more frequent

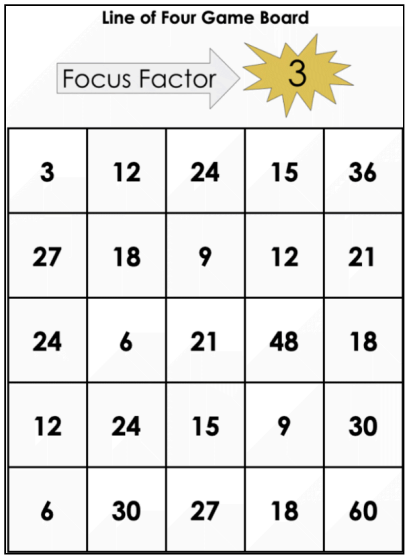
use of number stories to reflect the mathematical operations of addition and subtraction. The existing number stories involve a teacher telling a story such as, "There are 3 birds in the tree. Now 2 more birds join them. How many birds are now there?" The birds and trees could easily be replaced by objects and locations that are more community-based and relevant to learners.

Additionally, the *Power* dimension could be enhanced by allowing students to have more choice in these activities. Some teachers included this during the enactment of the instructional materials by allowing students to determine which activity out of two or three options they want to work on that day.

Designing Fluency Games to Support Formative Assessment and Equity-based Instruction

Overview

Figure 4 – Line of Four Game Board



This vignette describes the design and use of mathematical fluency games to address students' specific learning needs. This aligns with aspects of Access and Achievement, which form the Dominant Axis of Gutiérrez' framework (2009). In our current work, some of these games were used with Grade 4 students in a rural elementary school that includes a high percentage of students who are experiencing poverty (70%), students from historically marginalized populations (35% identify as Black, 30% identify as Latinx), and multilingual learners (35%) whose primary language at home is not English. Fluency games are intentional experiences that give learners opportunities to practice mathematical computation in the context of a game or activity. Effective games are conceptually-oriented and include access for students to use hands-on objects, pictures, or other strategies to scaffold the activity. Within the formative assessment process, teachers use data on their students' mathematics performance and can then select specific fluency games based on the data.

For this vignette we discuss the fluency game *Line of Four*, created by Emerald Education (emeralded.com, 2022), which was used as part of the *Fluency Games* project. Students play in pairs or groups of three and share one game board (example in Figure 4). The goal of the game is for one person to cover four boxes in a row, like the well-known game *Connect Four*. On their turn, a student pulls a number card and multiplies it by the Focus Factor, which in Figure 4 is 3. For example, if the student pulls a 6 from the deck, they can cover up the product of 6 and 3, which is 18, or they can double that product and cover up 36.

Connection between Fluency Games and Formative Assessment

The game aligns with the formative assessment process in that each pair or group of students can be asked to play with a different game board. Each game board has a different focus factor from 2 up through 9. The game was designed so that either teachers can assign or students can choose a game board to play based on data related to what numbers students need for additional learning experiences. To help teachers select a game board

that meet the needs and desires of learners, the game designers included a Teacher Observation Tool (see Figure 5) that can help teachers know what skills and strategies to look for as students play the game. The design of the observation tool includes opportunities for teachers to observe and listen for evidence of skills that align to the state standards as well as explanations from students that they understand the concepts.

Figure 5 – Sample from Teacher Observation Tool

Skills and Strategies	Observation Notes
Students can… • use strategies to determine the product when given two one-digit factors • use benchmark factors (e.g., 5) to help find the product when one factor is larger than 5 (e.g., how can 8x5 help find 8x7). • orally explain how they determined the product or quotient • orally explain why they made a specific decision during a game based on the math embedded in the game • orally explain which multiplication/division combinations they know from memory • orally explain which multiplication/division combinations they need more experience with	

Outcomes

Preliminary data analyses from the data in the current project suggests that playing fluency games three times a week has led to pretest to posttest gains in students' fluency scores. This work may provide empirical evidence to support recommendations for the design and use of additional fluency games. This is specifically critical when discussing equity and justice and the education of students who have been historically marginalized or who are currently experiencing poverty. Students in these demographic groups tend to perform lower than their peers on high-stakes assessments, which causes educational leaders and teachers to do more test-focused activities, instead of providing learning experiences that are more conceptually-oriented. While fluency games do allow students to develop conceptual understanding, develop students' knowledge related to the mathematical operations, and advance equity-based practices, more research is needed on their specific influence on student learning outcomes.

Equity Framework Reflection for Fluency Games

When examining the fluency game *Line of Four* through the lens of Gutiérrez' equity framework (2009), there are positive elements on all four dimensions. In terms of the dominant axis, the focus on fluency aligns with the Access dimensions since multiplication fluency is emphasized in Grade 3 and 4 mathematics standards and is foundational for other mathematics concepts also included in the standards. Games for students are typically appealing and engaging and this supports their ability to engage, learn, and achieve. Additionally, the games also provide access to fluency learning opportunities that are more engaging and easier to complete than the more traditional flashcards and worksheets that are not supported by research. Thus, we argue fluency is foundational to future achievement and access to higher-level mathematics, which compose the dominant axis of Gutiérrez' (2009) framework.

In terms of the critical axis and the Power dimension, the use of the mathematics games may not necessarily disrupt systems and power imbalances towards students who have been historically marginalized. However, there is evidence of supporting the Power dimension on the critical axis since teachers are giving students choice and some autonomy during the activity (Buchheister et al., 2019; Gutiérrez', 2009). The Power dimension could be further enhanced by providing students with access to mathematics tools and scaffolds such as graph paper, counters or other hands-on manipulatives, or paper to draw representations.

Similarly, there is limited alignment of this activity to the Identity dimension, since there were no opportunities for students to see themselves reflected in the fluency games. However, based on the design of the game, students were able to see themselves as doers of mathematics and as capable of successfully doing mathematics (Buchheister et al., 2019). If this game were more contextualized in real-life scenarios such as some of Emerald Education's other fluency games, there is a greater likelihood students would see themselves reflected more in the instructional materials. For example, in the game, *Hiking through the Decades,* students are taking a hike or nature walk. During the game, the numbers that they choose and their work on the various problems influences how far they travel. While some fluency games are better aligned to the *Identity* dimension, this is not the case with all fluency games in the field of mathematics education.

While the design itself of the *Line of Four* game includes aspects of equity-based teaching, the implementation of the game in the classroom also has potential equitable and inequitable elements. Consider, for example, teachers who want to support students by giving them access to something to help them with their recall of multiplication combinations. If a teacher provides them with graph paper so they can draw representations and pictures or use multiplication strategies, that would be considered as positively aligning with ideas of equity, since it scaffolds the activity and provides access to mathematics, which in turn may improve students' achievement. However, if a teacher allows students to use a calculator or a chart with all of the multiplication combinations, the opportunity to think and reason is removed from the activity, and students therefore would not have access to learning opportunities due to the over-scaffolding. Another possible implementation limitation is teachers' or students' selection of the game board to play. If a teacher disregards their data and simply has students use randomly-assigned game boards, they could be either too easy or too challenging, which in turn may limit the potential for access and achievement related to the math games. These instances would limit or deny students' interaction to equitable mathematics practices.

Discussion and Implications

There are multiple implications to consider regarding the design of both professional learning experiences for teachers and instructional activities for formative assessment in elementary mathematics related to advancing equity-based practices. In this section, we focus on two salient implications: 1) designing formative assessment resources that include embedded equity-based practices; and 2) designing professional learning experiences for teachers that advance the use of equity-based practices.

Designing Formative Assessment (and Other) Resources with Embedded Equity-based Practices

The first vignette illustrated the ways in which an internet-based formative assessment program aligned with elements of Gutiérrez' (2009) framework. Specifically, the use of data to inform teachers' selection of associated follow-up instructional activities aligned with the Access and Achievement dimensions on the dominant axis. Access was addressed through the program and associated activities providing research-based scaffolds to allow learners to engage in mathematics concepts. The achievement dimension was addressed through the cyclical process of using data to inform future learning activities and formative assessment processes to check students' understanding of those mathematics concepts. In terms of the Identity and Power dimensions on the critical axis, the alignment was more mixed. On the one hand, there was no evidence that systemic power structures were disrupted, and problems were not specifically designed to allow students to see themselves in the problems. On the other hand, formative assessment cycles do increase involvement of student voice in instructional decisions and improving student achievement through formative assessment can lead students to identify as mathematicians. However, no data was collected about students' identity development during the project. Future work informed by Gutiérrez' (2009) framework should examine what specific research and design efforts can help address the Critical axis and the dimensions of Identity and Power, including measures focused on student identity change and distribution of power in the classroom.

The second vignette examined the ways in which a fluency game included aspects that aligned with Gutiérrez's framework. Again, the dominant axis of Access and Achievement were evident in the design of the game: high engagement level for students, alignment with Standards, and addressing fluency, a key skill for achievement in mathematics. Also, similar to the formative assessment vignette, the critical axis of power and identity had mixed alignment. The same problems were found: no explicit disruption of power or design of problems to be contextualized in ways that highlight identities or contexts of high relevance to marginalized youth. However, power and identity were supported by student choice within the game. The second vignette also discussed equity issues related to implementation: teacher and student choices may undercut the access and achievement elements by poorly choosing games to play.

Educational designers should embed elements of equity-based instructional practices explicitly within the instructional resources that they develop and create. Previous studies (Martin et al., 2016; Polly et al., 2016) found that teachers tend to use these examined resources in three different ways: 1) use exactly as written in the teacher edition or resource guide, 2) modify the use of the resource slightly but still uses them in a way that aligns to its intended use, or 3) use the resource in a limited fashion in a way that does not align to its intended use. In the case of mathematics resources, a clear example is taking one of these student-centered activities that should include inquiry and student exploration and having a teacher use the resource by over-guiding and directing students through every step (McGee et al., 2013; Polly, 2016).

For teachers who use instructional resources in the first or second manner described above, those teachers are likely to enact equity-based practices in their classrooms. Previous research found that teachers who use resources without equity-based practices embedded in them rarely enact equity-based practices in their classrooms (Polly, 2021). While that finding seems intuitive, it is a good reminder for designers that both the

instructional resources and the support provided to educators must include both aspects of equity-based practices as well as scaffolds to help teachers enact these resources in ways that maintain the integrity of the instructional activities.

Providing Professional Learning on Equity-based Practices

Intentionality and reflection are critical pieces to designing instruction and activities that align with the goals and objectives that enable an effective mathematics learning environment. Stein and Smith (1998) provide a task analysis guide that describes qualities of tasks that require a low level of cognitive demand and those that would require higher levels of demand. The guide includes four levels of cognitive demand: memorization, procedures without connection, procedures with connection, and doing mathematics. In mathematics education, this tool becomes part of instruction for pre-service teachers and in professional development as we recognize that the tasks we place before our students must be of high quality to be effective. This requires teachers to carefully review materials and revise as needed. Similarly, it is important to develop teachers' ability to engage in questioning strategies that encourage greater depth of thinking, as the types of questions posed determine these interactions (Herbel-Eisenmann & Breyfogle, 2005; Martino & Maher, 1999). The list of effective teaching practices in mathematics that are well supported by research is numerous. Professional development continues to support teachers as math educators and to ensure equity is at the center of their development, we need to equip teachers with an equity lens that will facilitate their own evaluation of instructional plans.

In our first implication, we suggested directly embedding equity-based instructional practices into resources. This may take time to become a widespread practice. In the meantime, professional learning should support teachers by introducing research or frameworks such as Gutiérrez' (2009) framework, Kalinec-Craig's (2017) framework for promoting equity through formative assessment, Ball's (2022) discussion of discretionary spaces, or other seminal works that help provide teachers with an equity lens to evaluate the tasks and instructional practices we bring to our classrooms. In the vignettes, we emulate the process of evaluating the two instructional practices and their relationship to building equity. Professional learning should support teachers in this process so they can reflect and be intentional in their choices to promote equity.

Concluding Thoughts

The role of educational designers is vital as we consider how to increase the enactment of equity-based practices in mathematics classrooms. In this article, we provided examples about how the formative assessment process coupled with instructional activities could help teachers implement equity-based practices in their mathematics classrooms, as well as critical reflections on how the designed might be improved. This reflection suggests several new lines of research. The first could examine how specific instructional resources influence the use of equity-based practices. Such studies would examine the aspects of these instructional resources, the preparation needed by teachers, and how these instructional resources were enacted in classrooms. Data sources such as student surveys (especially related to power and identity), classroom observations (especially related to power distribution), and student outcome data, including student work samples, could examine how specific resources influence the use of equity-based mathematics practices. This first line of research also includes the examination of how teachers may modify or adapt resources and how those changes influence the use of equity-based practices.

The second line of research could be more broadly focused on aspects of instructional resources aimed at advancing teachers' use of equity-based practices. For example, research studies could examine how multiple resources with similar aspects influence teachers' enactment of equity-based practices such as whether there are especially large effects of using multiple games on the enactment of equity-based practices, students' understanding of concepts, as well as teacher and student reactions. Educational designers could benefit from this line of research since these studies could inform them of specific characteristics and aspects that should be included when designing instructional resources that may interact with related resources.

This paper provides background and examples of how designers of mathematics instructional activities have embedded equity-based practices in their instructional materials. Using a framework of formative assessment and explicitly connecting aspects of Gutiérrez' (2009, 2012) framework of equity-based mathematics teaching, it is definitely possible for educational designers to consider how to design activities that embed instructional practices. Still though, teachers need to have access to high-quality professional learning experiences as well as autonomy to make teacher decisions about the specific use of these resources. Afterall, providing instructional resources that teachers must follow like a step-by-step script is harmful to students, and it also greatly hinders aspects of equity-based teaching (Polly, 2021).

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