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Aprendiendo como incorporar elementos socioculturales en Educación Matemática

Learning how to incorporate sociocultural elements in Mathematics Education

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Resumen

Los participantes de este minicurso tendrán la oportunidad de aprender en forma activa y participativa como incorporar aspectos culturales y lingüísticos en la enseñanza y aprendizaje de las matemáticas. Nos basaremos en nuestra experiencia trabajando con profesores, estudiantes y padres y madres de familia en comunidades de origen mexicano en Estados Unidos. Las actividades de aprendizaje del minicurso están diseñadas bajo lineamientos teóricos basados en los conceptos de fondos de conocimiento y calidad de enseñanza con estudiantes cuya primera lengua no es la lengua de enseñanza en la escuela. La implementación de actividades se dividirá en tres partes: (1) una breve introducción de los conceptos teóricos y principios de diseño de las actividades, (2) observación y análisis de situaciones reales de aula, (3) observación y análisis de talleres matemáticos con familias. El minicurso finalizará con una discusión sobre cómo diseñar actividades en el contexto propio de los participantes.

Palabras Clave: Equidad; Prácticas de enseñanza en matemáticas; Fondos de conocimiento; Aspectos culturales y lingüísticos; Participación de las familias.

Abstract

Participants in this minicourse will have the opportunity to learn actively how to incorporate cultural and linguistic aspects into the teaching and learning of mathematics. We based our work on our work with teachers, students, and parents from communities of Mexican origin in the United States. The learning activities of this minicourse are designed under theoretical approaches based on the concept of funds of knowledge and quality of education for students whose first language is not the language of instruction in school. The implementation of activities will be divided into three parts: (1) a brief introduction of the theoretical concepts and design principles of the activities, (2) observation and analysis of actual classroom situations, and (3) observation and analysis of mathematical workshop with families. The minicourse will end with a discussion about how to design activities in the context of the participants.

Keywords: Equity; Mathematics teaching practices; Funds of knowledge; Cultural and linguistic aspects; Family engagement

Introduction

In this minicourse, we describe the activities that will be implemented during the session. We start with a brief introduction of the theoretical concepts drawn from our work in mathematics education with teachers, students, and families from communities primarily of Mexican origin in the United States. Grounded on a sociocultural approach to research, we designed the activities on linguistic and cultural diversity as assets for the teaching and learning of mathematics. Next, we will engage participants in observations and analysis of classrooms and workshops with respect to these elements. We will end with a discussion about how to design activities in the context of the participants.

Theoretical Concepts and Design Principles

The quality of mathematics education for bilingual students goes beyond good teaching practices identified in monolingual settings (Celedón-Pattichis & Ramirez, 2012). These practices include the teacher creating a safe intellectual environment where the native language is honored, a recognition or noticing that the meaning of words is fundamental to approaching a mathematical task. Other strategies include the task's context being based on a real-life situation, providing a visual representation of the objects, and using cognates (Sorto & Bower, 2017; Chval & Chávez, 2011). Design principles of activities based on these practices required real examples from classroom observations with at least one element clearly observable. Examples include whole class lessons, short video clips, transcripts, or vignettes. A clear description of the observed element and a quality level should accompany the example(s). Teachers should have time to observe the lesson (or read the transcript) multiple times, if necessary, before engaging in the analysis. The observation and analysis should be done individually before discussing in pairs or small groups.

Our work with families and mathematics is grounded on the concepts of funds of knowledge (González et al., 2005) and parents as intellectual resources (Civil & Andrade, 2003). Funds of knowledge refers to the “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being” (Moll et al., 1992, p. 133). The idea is that all communities have a richness of knowledge and experiences that can be leveraged for school teaching and learning. At the center of the funds of knowledge work is the idea of teachers learning about and from their students’ families and communities. As we started having mathematical workshops with parents, we realized that we needed to develop a two-way dialogue between home and school, where parents and teachers (as well as researchers) would learn from and with each other. For example, in an activity on the mathematics of “Papel Picado” (a craft that is quite typical in our local Mexican American context), the mothers became the leaders as they taught the researchers how to do it (Civil & Andrade). This initial work with a group of mothers led to the concept of parents as intellectual resources. As Civil and Andrade write, “In looking at home-school partnerships, there seemed to us to be urgency for parents to be intellectually engaged, especially mothers in language minority and working-class communities” (pp. 155-156). This idea of parents as knowledge holders and experts guides the work that we do in the mathematics workshops with parents and families that we illustrate in this minicourse.

Classroom Observation and Analysis Activity

Teachers can learn how to implement these practices by observing examples of classrooms from videotaped lessons and analyzing the situations utilizing a common rubric to capture the elements at different levels of quality (see Table 1 for an example of one element). The goal of the observation and analysis is to identify the extent to which multilingual learners have opportunities to reason and do mathematics while learning the language of instruction.

Illustrating the teaching elements and levels of quality

Participants in the minicourse will be exposed to video clips that illustrate effective teaching practices for multilingual learners. They will also hand out a rubric describing each level's elements and descriptions (Not Present, Low, Medium, and High). The facilitators will use video clips to illustrate each element and provide the corresponding level of quality. Participants will have the opportunity to become familiar with the rubric and question the decisions about the different levels of quality.

Observing and analyzing practice

Participants will then observe a different video clip, identify the elements they observe, and then assign a level of quality according to the rubric. This first observation and assignation of level will be done individually before discussing in small groups. When discussing the observation in small groups, the participants should focus the discussion on the observable teaching moves and the alignment with the rubric.

Reflection

Participants will be asked to compare and contrast the examples given and their own classrooms and to reflect on how this activity helps them better serve their multilingual learners.

Table 1
Teaching element and corresponding levels of quality

Meaning and multiple meanings of words			
Teacher or students communicate meaning by using synonyms, gestures, drawings, cognates, or translations to students' first language that supports the learning. This code includes reading strategies meant to increase comprehension. Meaning that occurs between students that is correct can adjust the score upward.			
Not Present	Low	Mid	High
No opportunities for students to explore the meaning through speech and other forms of expression are found. OR The translation/meaning is incorrect, or the use of gestures to convey meaning is confusing.	Brief opportunities for students to explore the meaning of speech and other forms of expression are found. Examples: ● Correct translation and support of math terms. ● Use of gestures to convey meaning, e.g., pointing, as when indicating the apex of a pyramid ● Use of synonyms ● Use of drawings ● Use of cognates	The teacher or students engage in a discussion of words or terms used in mathematical contexts or tasks that has the features noted under High, but it occurs in an isolated instance and does not characterize the segment.	The teacher and students explore the meaning of words or terms used in mathematical contexts or tasks through speech and other forms of expression in an extended way. Examples are: ● A conversation about the multiple meanings of mathematical words (mathematical meanings and/or colloquial meanings). ● Emphasis on cognates ● Use of a combination of techniques such as gestures, drawings, and the use of synonyms to convey meaning.

Source: Sorto et al., 2018

Mathematics Workshops with Families

In this minicourse participants will learn about different approaches that we have used to engage with families in mathematics explorations, including mathematics for parents (MFP) short courses, mathematics workshops for families co-facilitated by parents in the community, *tertulias matemáticas* where parents do mathematics but also engage in critical conversations about mathematics education, and parents' mathematics classroom visits.

After a brief overview of these different approaches, we will focus on examples from a MFP, a *tertulia matemática* session, and a parent-child interaction in a mathematics workshop. Through video clips of these different activities, we aim to emphasize the importance of the

linguistic and cultural contexts when working with parents and families. We also emphasize an asset-based view in our analysis of these activities, by which we learn with and from the families. An example from a tertulia involves a grandmother (Celia) and her daughter (Martina) (who was the mother of a child in that school) working on adjusting a recipe for horchata from four to six people (Menéndez & Civil, 2009). Celia had brought in an horchata recipe for 4 people based on her own experience making this drink.

The recipe called for $\frac{1}{4}$ kg of rice for 4 people. The question then was “how much rice would be needed for 6 people.” Martina who had at least a high school level education had taken the lead in the activity and said that it would be $\frac{1}{2}$ kg. In hearing that, Celia (who had attended school only till 2nd grade) right away said that it was not right. Celia and Martina then engage in an exchange in which Martina seems to be trying out numbers to see if any of them may be right while Celia is providing key ideas throughout, such as “it is going to be half of a fourth for two more people.” That is, if we need $\frac{1}{4}$ kg of rice for 4 people, then Celia is arguing that for 2 people it would be half of that, hence the “half of fourth” so that for 6 people it would be the $\frac{1}{4}$ kg plus the half of a fourth. At this point they are not sure how to proceed. Martina says “if you put it all together, it’s three fourths” somehow implying that $\frac{1}{4}$ plus half of a fourth would be $\frac{3}{4}$. And from there she concludes that it is 750 g (which would be $\frac{3}{4}$ kg). Celia is not convinced at all and says “one fourth is 250 grams, then half of 250 grams is one hundred....” To which Martina says “twenty-five” and Celia then says “one hundred twenty-five” and after doing some calculation on paper Celia concludes “three hundred seventy-five”, which is the correct amount of rice for 6 people.

This is just one example of how a culturally based activity such as adjusting a recipe that the participants chose leads to a context to discuss proportional reasoning and also illustrates the richness of Celia’s experiential knowledge and her sense-making. While Martina had arguably more formal education, Celia draws on her everyday experience and knows that $\frac{1}{2}$ kg would be too much rice for 6 people. While Celia did hesitate a little bit on how to find half of 250 and Martina helped there, still throughout Celia was contrasting the different answers given to what she felt was the case given her experience. This back and forth in the groups as they worked on the problems is a feature we want to highlight in this work, as it shows the participants’ engagement and the power of collaboration. As one of the participants I these *tertulias* shared:

We are all wonderful because we don’t make anybody else feel inferior.... There are things that maybe I didn’t get and for example maybe [another participant] did, and she can tell me “well it’s like this.” So then nobody, we don’t feel, nobody feels inferior to anybody else. And we help each other. That’s what we notice. If the gentleman [a participant in the group] knows something that I don’t, he teaches us or we teach. We all help each other.

Conclusion

The main goal of this minicourse is to engage participants in activities designed for teachers and families grounded on sociocultural and language theories with a non-deficit approach. By observing and identifying teaching elements of multilingual mathematics lessons, the participants will have the opportunity to reflect on their practice and have the tools to create more equitable learning experiences. The activities related to family engagement will serve as a

context to discuss with the audience avenues to working with families as resources for the teaching and learning of mathematics. We will look at some key principles that we argue should guide this work while keeping in mind the characteristics of the local contexts.

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