Reflection Within Mathematics Methods: Prospective Teachers Develop A Classroom Diversity Teaching Assignment

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Abstract

Prospective teachers can learn about and practice ethnomathematics teaching to students in the elementary classroom through multicultural children’s mathematics literature. Forty-seven prospective elementary teachers taking a mathematics methods course at a Doctoral Intensive University in the Rocky Mountain Region participated in a Classroom Diversity Teaching Assignment which includes planning, teaching the lesson to elementary students, reflection using transcriptions with focus questions, and oral reflection with the professor. Prospective teachers found this assignment beneficial.

Keywords: Ethnomathematics; Diversity Assignment; Prospective Elementary Teachers; Case Study; Transcription

Introduction

Ethnomathematics provides a natural means for students to access a framework for conceptual understanding in mathematics. Each student’s cultural reference, worldview, and history are unique to the experiences this child has encountered. Furthermore, these experiences may be incorporated into the classroom to help students learn authentic mathematics. This structure of culture is a mind-set integrating the prior knowledge of students in a way that builds upon what they already know leading to mathematical understanding. Nuri Robins, Lindsey, Lindsey, and Terrell (2006) posit to be a culturally proficient teacher one needs to teach “in a manner that builds understanding of the teacher’s and learner’s world that engenders a value of diversity” (p. IX). The National Council of Teachers of Mathematics (2005) take this one step further by explaining “…all students need the opportunity to learn challenging mathematics from a well qualified teacher who will make connections to the background, needs, and cultures of all learners”.
Ethnomathematics provides teachers the building blocks connecting students’ out of school mathematics knowledge with their classroom mathematics knowledge. By making the school to home mathematical connection explicit teachers can create connections with the mathematics they know already found in their worlds. Doing so also allows teachers to enhance and restore cultural dignity to the children in their classrooms with meaningful mathematics understanding (D’Ambrosio, 2002).

Prospective elementary teachers may use children’s literature to incorporate cultural ideas and build upon student experiences connecting real life to classroom mathematics learning. These books can cover a wide variety of mathematics understanding based on the characters and concepts in the story. An example is *Gabriela’s Beautiful Carpet/La bella alfombra de Gabriela* by Thompson and Thompson (2003). This story is set in Antigua Guatemala where the village is creating “carpets” in the road out of flowers, colored sawdust, and stencils (cardboard with wooden frames) for the religious Lenten procession that takes place in their community. These carpets use the mathematics concepts of patterns, symmetry, proportions, and geometry. By reading this book together as a whole class, (1) the foundational knowledge of “carpets” can help the students who have participated in these processions to connect real world mathematics knowledge to more abstract mathematics principles and (2) the other students in the classroom, who have never participated in a “carpet” procession, will have the knowledge and information to think about these mathematics principles in new ways to extend their knowledge to the real world. Multicultural children’s mathematics literature is a means to create mathematics connections by opening the world for the students through this shared experience.

**Literature Review**

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Many authors have defined “ethnomathematics”. D’Ambrosio (2006), known as the father of ethnomathematics, defines it with the “roots *roots*, *asics, mathema*, and *etho* to signify that there are various ways, techniques, abilities (*tics*) to explain, understand, deal with, and live with (*mathema*) distinct natural and socio-cultural contexts of reality (*ethos*)” (p. 48, *italics* original).

Borba (1990) defines ethnomathematics as the mathematical knowledge articulated in the language code of a specified socio-cultural group. Similarly, Eglash, Bennett, O’Donnell, Jennings, and Cintrorino (2006) define ethnomathematics as the study of mathematical ideas and practices positioned in people’s cultural context. Moreover, Powell and Frankenstein (1997) assert, “Ethnomathematics includes the mathematical ideas of peoples, manifested in written or non-written, oral or non-oral forms” (p. 9).

In addition, Barton (1996) states ethnomathematics is an instrument by which people may make sense of their world, as they see it, and as others see it. Furthermore, Powell (2002) claims ethnomathematics departs from a universal notion of mathematical knowledge benefiting male, European, heterosexual, racist, and capitalistic interests and values. Izmirli (2011) necessitates “exposing students to the mathematics of different cultures so as to increase their social awareness, to reinforce cultural self-respect, and to offer a cohesive view of cultures” (p. 39).

However, Ascher and Ascher (1997) contend “ethnomathematics is the study of mathematical ideas of nonliterate peoples” (p. 26).

The above definitions of ethnomathematics can be brought to life in the kindergarten through fifth grade classroom through multicultural children’s mathematics literature. Prospective teachers need the guidance in being able to teach mathematics in culturally relevant ways while equipping them with various approaches to teach students from different cultures and backgrounds (Blakeney-Williams & Daly, 2013; Harding-DeKam, 2014). Multicultural
children’s mathematics literature represents a unique art form in children’s literature because they encompass representations of the variety of ethnic, racial, and cultural groups around the world. Young children can develop awareness and understanding of cultural groups outside of their own through multicultural children’s mathematics literature (Loyd, Harding-DeKam, & Hamilton, 2015). For children from non-dominant cultures, the books also can affirm their own cultural identities (Mendoza & Reese, 2001) as well as serve the dual purpose of a mirror to reflect one’s own culture and of a window for learning about other cultures (Sims Bishop, 1997). Multicultural children’s mathematics literature can be a powerful way to facilitate culturally responsive math instruction as they extend students’ literary experiences beyond the lived experiences of the various members of the learning community. “The characters and situations in books introduce children to what the world may look like through others’ eyes and offer a change to further construct their own views of self and the world” (Mendoza & Reese, 2001). With a rich resource of multicultural picturebooks, all the members of the learning community can expand their cultural references, worldviews, and color their cognitive histories in pluralistic ways.

Methodology

Research Questions

The goal of this research is to evaluate the impact of ethnomathematics teaching through multicultural children’s mathematics literature in a mathematics methods course from the perception of prospective elementary teachers. The following research questions were addressed in this study:
1. How effective is the ethnomathematics instruction through implementing WIDA Standards and student learning objectives into lesson plans, and the Classroom Diversity Teaching Assignment?

2. Is transcription effective for prospective teachers as a reflection tool?

Participants

These participants are forty-seven prospective elementary teachers taking a mathematics methods course while completing a math practicum in an elementary classroom (grades kindergarten through fifth grade) using multicultural children’s mathematics literature. This is a purposeful sample of pre-service elementary teachers who are in the professor’s mathematics methods courses (early childhood, undergraduate, and graduate). These prospective elementary teachers are female (90%), twenty to twenty-five years of age (59%), and of white ethnicity (94%). The participants are at a Doctoral Intensive University in the Rocky Mountain Region.

Data Collection Procedures

Data was collected during a mathematics methods course from August to December 2015 as part of the regular course assignments focusing on quality math instruction using multicultural children’s mathematics literature. The following data were collected: (1) classroom diversity math lesson plan with professor feedback, (2) audio recordings of prospective teachers teaching with multicultural children’s mathematics literature to elementary children, (3) reflection paper of teaching experience by prospective teachers after transcribing and analyzing their own teaching, and (4) audio recording of interviews with prospective teachers after teaching cycle: lesson plan, teaching, and reflection (semi structured questions).

Data Analysis
This is a case study design providing a holistic portrayal of perceived prospective teachers’ integration of multicultural children’s mathematics literature into mathematics instruction (Creswell, 2009; Yin, 2009). The data above was collected, transcribed, and organized. These data were coded and analyzed for themes and patterns (Marriam, 1998; Saldaña, 2009) to answer the before mentioned research questions. Credibility issues were addressed by using a second coder, expert/peer checks, triangulation, and member checks (Merriam, 1998).

**Mathematics Methods Course Structure**

The timing of the mathematics methods course, where how to teach mathematics to children is the focus, has changed from being the same semester as student teaching to the semester prior to student teaching. This change has positioned the mathematics methods course with a mathematics and science practicum. With access to this practicum, my prospective teachers have the opportunity to apply what they are learning to students in the kindergarten through fifth grade classroom. This application of teaching mathematics allows prospective teachers to put their philosophy and math content knowledge into action.

**Mathematics Methods**

My mathematics methods course over the past decade has evolved to include more ethnomathematics and culturally diverse classroom experiences than the Farsi video, human graph, and a specific section in the lesson plan for children learning second languages and diverse cultures (Harding-DeKam, 2007). These additions include: adding WIDA standards and learning objectives to the lesson plan and the Classroom Diversity Teaching Assignment enriching my prospective elementary teachers understanding of teaching mathematics to the diverse children in their classroom.
Modeling Mathematics Instruction with Language Supports

Modeling in my mathematics methods course now focuses on specific language supports allowing students to access the content. Specific math vocabulary instruction, representation, and differentiation have a more purposefully focus of teaching. Mathematics vocabulary is taught with visuals (photographs, images, symbols) and written in a language other than English to support academic language. This mathematic vocabulary is then posted around the classroom as a resource. Mathematics concepts are presented with multiple modes of representation such as nonverbal, oral, graphic, written, objects, manipulatives, and technology. These concrete examples support conceptual understanding for all students, but give English Learners (ELs) an understanding even if there is a language barrier. Differentiation is made explicit by modeling how the mathematics concepts can be taught to a diverse group of students at the same time such as ELs, students who understand the concept, students who do not understand the concept, Gifted Learners, Special Needs learners, students who have negative attitudes about math, etc. These specific language supports are modeled in my mathematics methods classroom giving prospective teachers strategies to take with them into their practicum teaching experience.

WIDA Standards and Learning Objectives

WIDA advances academic language development and academic achievement for kindergarten through twelfth grade linguistically diverse students through high quality standards, assessments, research, and professional development for educators (WIDA, 2016). Previously, prospective teachers in my mathematics methods course would create lesson plans including specific content standards from the Colorado Academic Standards with appropriate learning objectives. Now, my prospective teachers add the mathematics WIDA standard with a specific learning objective to their lesson plans as you can see in the example below.
Standards-Based Instruction

WIDA: English Language Development:

Standard 3 – English Language Learners communicate information, ideas, and concepts necessary for academic success in the content area of mathematics. To meet this English Language Development standard, students will:

• Use mathematic vocabulary to describe to the class how they began their math process: I started solving the problem by __________.

By adding the WIDA standard and learning objective to mathematics lesson plans it guides my prospective teachers in thinking about how they will differentiate their instruction for English learners in their classroom. This opportunity allows prospective teachers to specifically plan for English learners in their classroom supporting them to be successful mathematics learners.

Classroom Diversity Teaching Assignment

The Classroom Diversity Teaching Assignment using multicultural children’s mathematics literature gives prospective teachers the opportunity to bring culture and diversity into mathematics teaching allowing all students to see themselves as mathematicians. The impact of this teaching happens when the prospective teachers have students from diverse cultures participate in the mathematics learning; furthermore, these students see their culture, group, or identity represented in the children’s book being successful with mathematics.

This is a four-part assignment for my mathematics methods prospective teachers: (1) complete a Classroom Diversity Math Lesson Plan for children in your partner school. The math content and date for teaching this lesson plan needs to be discussed and approved by your elementary classroom teacher prior to creating this lesson plan. You should plan for teaching at least half of an hour to the whole class. Lesson must use multicultural children’s mathematics literature book
to teach math like modeled in class. You may use the list of multicultural children’s
mathematics literature book list to find a book to use in your classroom. (2) After being approved
to teach your Diversity Math Lesson Plan by the professor, then you may teach children in your
classroom while audio recording your lesson. Make sure you and the children can be heard on
your audio recording. You will submit the raw audio recording and transcription focusing on
classroom dialogue and learning conversations to observe how effective your mathematics
teaching is through conversation. (3) Written Teaching Reflection discussing what went well
with the teaching of your math lesson and what you would do differently next time. Reflection
questions are below to help guide in this reflection. (4) Oral Reflection for fifteen minutes with
the professor to give feedback on classroom teaching, audio transcription, and reflection. You
will have time to discuss you teaching and ask any questions to help improve your practice
through the planning, implementation, or reflecting stage.

The Classroom Diversity Math Lesson Plan Rubric is how the professor evaluates the
mathematics lesson plan prior to the prospective teachers using the lesson with children. There
are four areas of evaluation in this rubric: (1) Lesson Plan Format: all sections of the lesson plan
are detailed including big understanding, materials, standards with learning objectives,
engagement, investigation, explain/clarify, conclusion, meeting the needs of all students, and
assessment. (2) Math Content: covers mathematics concept(s) in depth by acquiring, analyzing,
organizing and processing information. Math content is differentiated to meet the diverse
children in your classroom. (3) Multicultural Children’s Mathematics Literature Book: enhances
mathematics and cultural math concepts while reading aloud a diverse mathematics picturebook
to your students focusing on active student participation and genuine learning experiences (Loyd,
Harding-DeKam, & Hamilton, 2015). (4) Questions asked during the lesson: are high-level
questions with rigor allowing students to think mathematically and culturally. Specific questions are in lesson plan to guide math content understanding and integration with multicultural children’s mathematics literature.

After the teaching and transcription of the Classroom Diversity Math Lesson Plan, prospective teachers were asked to reflect on their teaching by analyzing their teaching transcriptions to focus on student and teacher mathematics conversations in general and then with specific guided written reflection questions to answer. The following question were reflected upon:

1. How do you feel the lesson went (what are your perceptions of your strengths of this lesson and what are your perceptions for areas of growth within this lesson)?
2. How did your lesson planning strengthen your teaching?
3. How did you further the students’ mathematical knowledge, skills, and engage them intellectually in understanding math subject matter?
4. How did integrating mathematics and diverse children’s picturebook work in your lesson?
5. What strategies did you use to monitor student learning during this teaching? How many students were successful in understanding this math content because of your teaching? Which students were not successful in understanding this math content because of your teaching?
6. How did you scaffold instruction (sheltered instruction, differentiation, modeling, vocabulary, etc.) for all children in your classroom (English language learners, students who understand the math concepts, students who do not understand the math concepts, special needs students, students who have negative attitudes about math, and gifted students)?
7. What did you learn about your teaching from your transcription? How can you understand what children understand or know about content from listening to what they say?

8. Overall, how would you rate the quality of your mathematics teaching to children on a 1 to 5 scale (1=no student learning, 2=a few students learned, 3=half of the class learned, 4=most of the class learned, and 5=every student in the class learned)? Why do you rate yourself this way?

Findings

Resoundingly the prospective teachers found the ethnomathematics focus within their mathematics methods course as beneficial through adding WIDA standards and learning objectives to the lesson plan as well as with the Classroom Diversity Teaching Assignment. Prospective teachers specifically found the teaching cycle as a positive experience of planning their lesson, receiving feedback from the professor on their lesson plan, teaching the lesson while audio recording it, answering focused reflection questions, and then meeting with the professor to discuss it.

Prospective teachers taught their lessons in kindergarten through fifth grade classrooms. For most of the prospective teachers this was their first mathematics lesson planned and taught in the elementary classroom. The mathematics content taught with the integration of ethnomathematics was varied including fractions, doubling, decimals, multiplication, integers, factorials, addition, area, perimeter, subtraction, patterns, measurement, counting, data analysis, graphing, money, mental math, geometry, estimation, even/odd, and symmetry. Examples of multicultural children’s mathematics literature taught from include: One Grain of Rice: A Mathematical Folktale by Demi, If America Were a Village: A Book About the People of the United Stated by

**Classroom Diversity Teaching Assignment**

Prospective teachers found the lesson planning process valuable allowing them to be prepared for teaching in the classroom. One hundred percent of the prospective teachers thought the lesson planning process were beneficial. There is a preponderance of planning benefits where it helps “imagine the whole picture of your lesson”, “create questions that lead students to think about content”, “deliver concepts clearly and correctly”, “boosted my confidence”, “reach content standards and WIDA objectives”, “pace the lesson”, “establish expectations”, “prepare all materials needed”, “decide what type of manipulative to use”, “connect to grade level expectations”, “prepare for modeling”, “identify vocab that needs to be explained”, “estimating time”, “integrating culture”, and “assessing students”.

The multicultural children’s mathematics literature book was effectively used to make the connection between math concepts and culture through discussion allowing classroom conversations about “families”, “food”, “real life applications in terms of culture: people, families, clothes, and beliefs”, and “realia”. Prospective teachers gave examples of students from other cultures who were engaged in the mathematics lesson because the characters, context, or activities in the stories were relatable to them: “cultural celebrations”, “nesting dolls”, “Native American blankets”, “home language”, “currency”, “measuring systems”, “type of food”, “their ethnicity”, and “their culture”. One prospective teacher mentioned about a stereotype
misunderstanding one student in her classroom had and how “through discussion we were able to clarify that those things were not true”.

There were some logistical issues with incorporating multicultural children’s mathematics literature into the classroom because it was not part of the normal mathematics curriculum. Several prospective teachers stated, “It was difficult planning a book into math because that isn’t what normally happens in the classroom” and “in my school they believe students should not be read to in math”. Furthermore, with some mathematics content areas it was difficult to find a multicultural children’s book at the appropriate developmental level for students, especially “a diverse one—to fit the lesson genuinely”. Despite these challenges, a majority of the prospective teachers believed the multicultural mathematics children’s book enhanced the lesson through student engagement, integration of content areas (social studies, language arts, and mathematics), and providing a visual or concrete understanding for the mathematics.

Transcriptions

Prospective teachers were required to listen to their audio-recorded teaching experience and to transcribe it, in order to reflect upon this experience. There were specific reflection questions given to guide the focus of the transcription on conversations taking place during their teaching (see above). Ninety-seven percent of the prospective teachers thought the transcription process were beneficial allowing them to evaluate their teaching. The following quotes reinforce using transcription to reflect upon what mathematics children are learning through classroom conversations: “allowed me to think about what students said”, “showed me where students made connections”, “listening to students lets me hear what they know”, and “tells me what I need to teach next”.

Prospective teachers felt the transcription process was useful as a tool to analyze their teaching
through the themes of focusing on student thinking, identifying where students made math and culture connections, and focusing on student understanding. One prospective teacher encompasses the overall sentiment about transcribing with “it was helpful to know what I have done and what I need to change in my future [teaching]”. On the other hand, a small group of prospective teachers (3%) thought transcribing was tedious and a “lot of work”, “not helpful”, and “didn’t seem to be worth the time”.

Prospective teachers identified many areas of strength as well as areas for improvement within their teaching through transcription. The areas for improvement included, (1) verbal communication: “talking too fast” or “saying filler words”, (2) instruction: “not much student conversation”, “should of asked more questions”, or “need to go deeper into concepts”, and (3) management: “heard students misbehaving that I missed while teaching” or “more wait time needed”.

Course Evaluation

Prospective teachers in the course evaluation found the Classroom Diversity Assignment as beneficial with their qualitative comments: “the diversity lesson provided a meaningful experience” and “the multicultural lesson was really helpful and it gave me the initiative to plan a lesson independent from my practicum teacher”. On the course evaluation, one hundred percent of the prospective teachers agreed or strongly agreed assignments and tests in the course were related to course objectives and the instructor created a classroom environment that as inclusive and respectful of diversity.

Discussion

Prospective elementary teachers benefit from the experience of planning, teaching, and reflecting upon their instruction. These prospective teachers perceive planning the lesson as a valuable
process in helping to think through and anticipate what was going to occur. Feedback and grading of their lesson plan prior to teaching it with children was appreciated allowing them to be more prepared and think through everything within the lesson. The act of teaching is a complex and multifaceted endeavor; furthermore, prospective teachers cannot catch everything happening in the moment because they are focused on classroom management, content being taught, pedagogy of teaching, classroom conversations, connections, and differentiation to name a few. Transcription provides the opportunity to slow down the teaching and learning process where prospective teachers can concentrate on what happened during their instruction through classroom conversations. Specific reflection questions guide the focus of what to focus on during the transcription. Additional oral reflection with the professor contributes to another level of reflection by getting feedback from an experienced teacher on what went well and ideas to improve upon in the future. The data suggests the Classroom Diversity Teaching Assignment is worth the time and effort for prospective teachers to complete in their mathematics methods course.

Conclusions

The modeling of mathematics instruction with language supports, addition of WIDA standards and learning objectives in lesson plans, the Classroom Diversity Teaching Assignment, and audio transcription experiences were deemed meaningful by the prospective elementary teachers in my mathematics methods course. Multicultural children’s mathematics literature seemed to make an impact on the children in the classroom by allowing them to relate to the stories, put mathematics into a concrete context, and see how everyone is a mathematician. However, more authentic multicultural children’s mathematics literature books need to be written for a variety of mathematics content areas at different
developmental levels in order to use them as a mathematics-teaching tool in the elementary classroom. Current mathematics curriculum in many schools is a narrow way of teaching mathematics where there is not any integration of subjects. This mathematics curriculum needs to be re-conceptualized in order to bring multicultural children’s mathematics literature to enlarge the conceptual understanding of mathematics and its connection to all people around the world.

Prospective teachers need to have high mathematical expectations for all students in the classroom. These expectations can be achieved by bringing ethnomathematics learning into the classroom where teachers know their students enough to individualize mathematics in a way that builds upon their prior knowledge of their personal history and home life. This can be accomplished through multicultural children’s mathematics literature. It is important to leave our students’ difference intact and their multiple identities recognized in order for them to make personal connections to mathematics.

References


Harris (Ed.), *Using multiethnic literature in the K-8 classroom* (pp. 1-20). Norwood, MA: Christopher-Gordon.

