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Ms. R. and Ms B. and the Coconut Unit Lesson

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Abstract. This short research-to-practice paper gives details about two first-grade teachers and their students using a locally-written and locally-set story about measurement as the center of a lesson. The report chronicles the journeys of the teachers in one elementary school in the Commonwealth of the Northern Mariana Islands (CNMI). Both teachers participated in a series of collaboration sessions led by the author. These sessions first introduced the teachers to the idea of ethnomathematics and the potential of adopting culturally-relevant approaches, and later provided support during implementation. The two teachers reported that the focused collaboration sessions and the implementation process effectively changed their teaching, their attitudes and knowledge of mathematics, and their understanding of curriculum. The paper recommends that others adopt a similar focused collaboration approach as a form of professional development for those who are interested in different approaches to teaching mathematics and developing curriculum.

1. Background

The Commonwealth of the Northern Mariana Islands, (CNMI) is comprised of 16 islands in the middle of the Pacific Ocean located east of Japan. The official languages of these islands are Chamorro and Carolinian with English as the official business language. Schools are taught in English. The islands are politically connected with the United States of America. In fact, the CNMI Public School System (PSS) follows the same federal mandates as schools in the U.S.

Many of the locals still speak the language and practice the culture of their great-grandparents. However, it is important to note that many aspects of island life have changed as a result of westernization and technology.

Research in ethnomathematics over the past several decades has been generated in many parts of the world. Such work emphasizes the use of culturally relevant and problem-solving rich mathematics. Until my dissertation work, there was no systematic research in the Commonwealth of the Northern Mariana Islands linking local Chamorro culture and mathematics teaching and learning. This paper presents some of that work. It is focused on two first grade teachers in the CNMI and their journey, as they collaborated to implement a problem-solving rich, ethnomathematics lesson using western and local units of measurement (e.g., diameter of a coconut).

1.1. Problem-Solving Rich Mathematics Curriculum. Problem-solving rich mathematical experiences exist in classrooms filled with students discussing their mathematical ideas, justifying their thoughts, and using a variety of manipulatives to illustrate ideas (Buschman, 2003; Hiebert, 1999). These classrooms rely on teachers noticing and supporting student discourse to gauge the progress of the learning and to decide on future lessons (Bray, Dixon, & Martinez, 2006). Lesson plans in such classrooms not only delineate the daily activities of the students but also include the questions that must be asked and anticipated in order to understand and push student thinking (Heng & Sudarshan, 2013; Nebesniak, 2013; Wallace, 2007).

Teachers in a problem-solving rich mathematics classroom observe the dynamics of the classroom and converse with the students. Often, as students become better problem-solvers, teachers step back and allow students to explore without interference, unless absolutely necessary (O'Donnell, 2006). After a period of exploration and student discourse, the teacher may call the class back together for group discussion. This is after teachers identify different types of thinking that were observed and ask those students or pairs to present their findings to the class for whole class discussion (Bray et al., 2006). Through these discussions, teachers can gain further insight into their students' thinking, which can assist them in decisions on how to segue into the next lesson. These discussions usually call attention to any difficulties students encounter (Sanders, 2009).

Rich discussions also provide opportunities to engage in the Common Core's eight mathematical practices (Council of Chief State School Officers [CCSSO], 2010, pp. 6-8). The Common Core standards are practiced in the CNMI.

1.2. Culturally-Relevant Mathematics. Ethnomathematics refers to the relationship between culture and mathematics (Barton, 1996; D'Ambrosio, 2001). Dr. Julie Kaomea frames ethnomathematics within the past, present, and future of the Hawaiian people (Kaomea, 2011). For this paper, it can include any aspect of the past, present, future, or a combination of any of those elements. An ethnomathematics curriculum cannot be limited to the past because some of the children, especially the children not native to the islands of the CNMI, may feel alienated and disjointed from the lessons. By connecting the past to the present and possibly to the future, all students can benefit from an ethnomathematics curriculum. Whenever a heterogeneous society exists, care must be taken to allow for entry points for every student. By linking the past to the present, all students can understand the context of the lesson and gain an appreciation for an indigenous culture.

Culture incorporates a people's beliefs, traditions, values, customs, and ways of life. This must be taught, it is not something one is born with (Wolcott, 1982). Dr. Katherine Aguon, a scholar from the island of Guam, notes that the purpose of education is to perpetuate the culture of the people and the place. She argues that in any society, the culture of the indigenous people must be perpetuated in schools. On the CNMI island of Saipan, that would be the Chamorro and Carolinian cultures (KUAM News Extra, 2011). The CNMI also is home to a large number of foreign contract laborers who are Filipino, Korean, and Japanese, and their children. The influx of these foreign contract laborers resulted from huge labor demands in the 1980s. In addition to the indigenous population and the contract labor population, some Americans from the United States call the CNMI home. Consequently, the culture in the CNMI is a mix of these various cultures. Those in the present and the cultures of the past have influenced the Chamorro and

Carolinian people as a result of the different occupying countries during the course of the history of the Marianas.

I am of Chamorro descent. My family is Ada, Atalig, Sablan, Taimanao, Diaz, Cabrera, Manglona, Camacho, San Nicolas, Tudela, Pangelinan, Reyes, and Borja. I understand that although I am considered indigenous on the islands, my blood that flows within my veins is a mixture of various genetic influences starting with my Chamorro ancestors, then during the Spanish occupation, my great- (maybe 3 or 4 "greats" ago) grandfather was a Spanish priest who, along with my great- ($\times 3$ or $\times 4$) grandmother, the maid of the chancery, gave life to the next person in my lineage who was no longer a pure Chamorro (Ancestry.com, 2012; Borja, 2012). This is the history of many people on our islands. However, we consider ourselves Chamorro.

Dr. Katherine Aguon (2011) explains that the concept of Chamorro culture is rooted in *inafa'maolek* or making good. She identifies six concepts in the language that embody the culture:

(1) *respetu* (respect),
(2) *manginge* (paying respect to elders),
(3) *mamahlao* (having shame),
(4) *chenchule* (social debt),
(5) *che'lu* (siblings), and
(6) *ptgon* (children).

These concepts in the Chamorro culture revolve around a community that is not limited to the nuclear family but extends to aunts, uncles, cousins, godparents, and grandparents. Mathematics that focuses on the individual and individual efforts may be an impediment to meaningful learning in the classroom. A culturally-relevant, problem-solving rich mathematics curriculum infuses the culture of the place with problem-solving rich mathematics (Bucknall, 1995). Its intent is to make education more meaningful for students (Agbo, 2001). Through a culturally-relevant curriculum, students can more easily create mathematical meaning via experiences that are real to them (Lipka et al., 2005).

Culturally-relevant curricula, in the context of the Chamorro culture, incorporates the six concepts delineated by Dr. Aguon through either a common, regularly practiced Chamorro cultural activity or a historical Chamorro activity. For example, a regularly practiced Chamorro cultural activity centers on the preparation of food for a fiesta. Chamorros and non-Chamorros of the islands can associate with the different foods and the efforts necessary for the preparation for the fiesta. An example of a historical activity includes the building of a latte-stone. These activities are examples from which the context of a problem-solving rich mathematical lesson can be derived.

Bucknall (1995) defined a successful indigenous class to include components of culturally-relevant mathematics and a challenging mathematical problem. As did researchers after her, such as Hiebert (1999), Buschman (2003), and Wallace (2007), she defined a problem-solving rich mathematical curriculum to include lessons that challenge the students to communicate, problem solve, reason and make sense of the problem, make connections, and use representations to engage in the mathematics. It was my intention to frame the thought-provoking aspect of mathematics within the context of the Chamorro culture.

In order for a curriculum to be successfully implemented, teachers must be fully vested in it. One valuable way this vesting can happen is when teachers are involved in the planning, implementing, and revising of the curriculum unit (Lipka et al., 2005; Willoughby, 2010).

2. Procedures and Data Gathering

Participation in the research began in May and continued through the following February. Teacher participation included monthly meetings of about an hour and their in-class implementations. The whole group of teachers consisted of four people: two who taught grade 1 at the same school and two who taught grade 4 at different schools. For this article, the focus is on the two first grade teachers. The activities in the lessons they implemented came from a series of collaboration sessions between the researcher (me) and the teachers. I initially created the unit through project MACIMISE (Mathematics and Culture in Micronesia: Integrating Societal Experiences) where it underwent a multitude of revisions by peers and professionals in the field of education. The final product from MACIMISE was used as the starting point for my work with the teachers in this project.

The results reported here emerged from study of video and/or audio recordings of pre-implementation, implementation, and collaboration sessions, field notes of direct observations of implementation of lessons, written self-reflections by the teacher participants in the study, background information provided by the teachers, and an interview after the final collaboration session using two sets of questions from a second, related, study that tracked the progress of teachers across many different islands and cultures as they implemented culturally relevant lessons.

3. Case Studies

3.1. Teachers. Heidi and Tara, pseudonyms of the first grade teachers, implemented their lessons concurrently (same days and same time period). Consequently, I only observed Heidi on a daily basis. My telling of Tara's story is a result of watching video recordings of her class, talking with her about her reflections during our collaboration sessions, and reading her written reflections. Heidi and Tara work at the same school so I observed both classes when both Tara and Heidi brought their students outdoors for day 2 of the lesson. Prior to the implementation of the first grade lessons, we met twice to confirm their plans for using the lessons for the unit and two more times with the entire group (not including the initial informational meeting).

3.1.1. *Heidi.* Heidi is a Chamorro who was born and raised on the island of Saipan. She highly values her culture and believes that in a lot of ways, it defines who she is. She wears jewelry that symbolizes our culture and teaches her children to speak the Chamorro language. In her home and in her presence (even outside of her home), she requires her children speak to her in Chamorro. Her husband is a local jewelry maker known for beautiful pieces of Chamorro jewelry. Whenever I have seen Heidi in the context of the research or before and after, outside of the research, we have spoken to each other in our native tongue and continue to do so unless we cannot find the words to express ourselves or are in the presence of individuals who don't speak the language. Heidi has been teaching for 13 years at the same school. She knew she wanted to become a teacher since the age of 8. She loves teaching. She believes that every child can learn

and each has their special way of learning. Heidi also believes that the onus is on the teacher to unlock the child's best way of learning so that they can be successful. She values patience, consistency, and persistence in herself as a teacher. She realizes that teaching and learning are processes and that perfection can never be achieved. She values mistakes as learning tools.

3.1.2. *Tara.* Tara has lived and taught in the CNMI for 23 years. She is a Caucasian from the state of Washington. She considers the CNMI her home because this is where she has made a home with her husband and her two boys. When she was a senior in high school, Tara decided that she wanted to become a teacher. She enjoys teaching. Like Heidi, she believes that every child can learn. She believes that it is her responsibility to think of different strategies of teaching to enhance learning. For Tara, learning never stops and people are always learning new things. She values professional development that can help her become a better teacher, which would in turn impact her students' learning. She has noted that she is a "drill and kill worksheet type of person in terms of math: I teach, then allow them to practice" (Interview notes).

3.2. Teaching Approaches. During the October session with the entire group, the teachers were given an opportunity to reflect on their mathematics teaching and share what they were doing in their classes at the moment to help their kids make sense of problems and persevere in solving math problems. Heidi responded with, "I did something different this year with the way I taught place-value. I went with the way Common Core explained it." She "flipped" the way she normally taught place value with her first graders: instead of telling kids where the places were they did an activity, "Bundles of 10." She instructed her students to count sticks and bundle them with 10 sticks per bundle. She reflected that some of her students had a difficult time counting despite the fact that they counted every day. During the Bundles of 10 activity, Heidi noticed her students "arguing." They were justifying to each other their ideas about what to do with extra sticks outside of their bundles of 10.

Through my interactions with Tara and through our discussions, it emerged that Tara's disposition towards mathematics and mathematics curriculum was different from Heidi's. Tara did not exude the mathematics confidence of Heidi. However, she shared Heidi's desire for self-improvement. At each session, Heidi usually asked the questions that others were hesitant to ask. Her questions were always welcomed by others and sparked further discussion. She offered constructive criticism whenever necessary, which caused me to further analyze the lessons and their intent. Tara was not as eager to try new approaches to mathematics. As a member of the study and as a teacher with a desire to improve, Tara was willing to try the mathematics strategies and approaches new to her but gave up when the content became difficult for her. She wanted and felt she needed much guidance. If the guidance was not offered to her, she typically sat back and waited for someone in the team to offer her assistance. With the assistance, she once again attempted to do the mathematics. During these times, she would remind the group that mathematics was not her thing but she was willing to try.

After our initial meetings of planning and doing some mathematics, we met again in October to reflect on mathematics in the classroom. Tara reflected on how, for the sake of time, she seldom used discovery learning. She typically tells and shows her students how to do things. Tara said the mathematical practice of letting the kids discover (versus telling them the answer) was a struggle for her. From as early as August, she was cognizant of this issue. She mentioned having to constantly remind herself to ask the students questions to help their thinking along versus jumping in and correcting them. She talked about time constraints. She wasn't comfortable

giving students the whole afternoon to experience tasks aimed at improving conceptual understanding. She was making an effort to improve at this. Tara said that her students don't have the language necessary to explain their thinking. As a result, she said, she listens to them and helps them with constructing their thoughts using academic language and has them repeat it.

The team of Heidi and Tara openly communicated with one another, freely asking questions, and not hesitating to ask for assistance from the others. Since they teach all subjects in 1st grade (with the exception of the Chamorro and Carolinian Language and Heritage Studies – CCLHS – class), they have come up with a system to help them plan their lessons to satisfy the requirements of their administration. In this system, Heidi is responsible for the plans for the mathematics lessons. As a result, Tara typically asks Heidi what they are doing the next week and they discuss the lesson before it is implemented. In this study, the planning was initially done by me.

3.3. The Focal Lesson. I had envisioned a curriculum unit that would fuse the western thoughts of mathematics with the ideas of our culture, the Chamorro culture. The story is about a boy, Jose, who needs to find his height because he needs to get a suit sewn for a school dance. It is set in the Marianas post World War II. The story incorporates the Chamorro culture and language as Jose ventures out into the village to find his height. Throughout the story, it is evident that the narrator is on an island where the culture and the language are not primarily western or English.

This lesson was brought to Heidi and Tara for their review and input. In June, the first month of collaboration, Heidi and Tara sat down and began talking about their upcoming school year and the new Common Core mandates thrust upon them by Central Office. Although I told them I would not be observing them until the following school year, Heidi decided to try out the lesson ideas with what she remembered from our meetings. I do not have data on these lessons except for whatever she revealed during our planning sessions. Because Heidi created her own version of this lesson, one that mimicked the part of a lesson when the students go out and measure their teammates, it gave Heidi a sense of confidence with the lesson. When asked, Tara indicated that she may have done a portion of the lesson, too, in the previous school year, but she couldn't recall.

The lesson was planned to be 5 days in length. The first day began with a story. The remaining 4 days focused on getting students to understand how to measure using non-standard units and then finally understand that measurement is a function of the unit used. After executing the lesson, we learned that the story was too long for first grade students to listen to in one sitting and recommended to break the story into a 2-day telling emerged. The length of each activity took longer than expected and teachers felt compelled to use other times in the day, throughout the day to implement the lessons. In the end, the teachers found value in creating an intense introduction to measurement because the students understood the targeted concept. Discussion on how and when to incorporate future measurement activities ensued at the conclusion of the project. The full lesson is available on the MACIMISE website: `http://macimise.prel.org`.

3.4. First Grade Implementation of Unit. Prior to reading the story, the teachers asked students, "How tall are you?" The responses the students provided revealed that students had a poor understanding of measurement units. Some students believed they were 8 feet tall. Heidi was surprised with the student understanding of measurement because she had shared a story of

a giant squid earlier in the year and the students had discussed and measured what 9 feet looked like. After checking her students' prior knowledge, Heidi previewed the story, "Jose's Many Heights" written by me, and read the story with many cultural pit-stops (points in the story where she stopped to talk about the Chamorro culture). Tara read the story without making any cultural pit-stops like Heidi. She felt that there was no need to elaborate during the cultural instances in the story because the students should already be aware of the culture since they lived in Saipan.

After school, for the five days of lesson use we met to reflect on the implementation of the lesson, discuss suggestions for future lessons, and to plan for the next day. The unit began with the story and segued into student experiences in measuring. Students began with measuring their heights, like the boy in the story, using one of the units in the story, coconuts. The subsequent days included students measuring their hands or feet or other objects in the class with different units of measurement. Each measuring day ended with class discussion on what had occurred, challenges, successes, and questions from the teacher in an effort to understand the level of student understanding. For example, at the end of Day 2 when the students measured their heights, the teacher asked the students to report their heights as a number of coconuts tall. Then she asked if that height would be the same number if counted in another unit in the story, bugs, instead.

4. Discussion

Through our sessions together, I found our conversations not only revolved around the mathematics but also on the teaching of the mathematics. My findings revealed the kinds of impact collaboration had on implementing something new that was not initiated by the teachers themselves: improved questioning techniques used by teachers, better understanding of the use of manipulatives in a lesson, enduring understandings gained by students, cultural connections, and confidence building. The teachers judged that the implementation of the unit was successful. To varying degrees both teachers in this study grew professionally through the use of the culturally-relevant, problem solving lessons and with the opportunity to collaborate with one another and with me.

The process I had the teachers experience through my project used the structures for effective teacher professional development in mathematics and science already identified in the literature (Blank & de las Alas, 2009): teachers from the same school collaborated before the implementation of the unit to understand how the unit would be implemented, then during the implementation of the unit they collaborated daily after each implementation session in class to discuss their successes and challenges, and finally, at the end of the implementation of the unit, the teachers reflected on the effectiveness of the lessons as a unit and discussed points for improvement for future use. What is noteworthy is that this approach proved equally effective when the professional development was for a paired attention to both culture and mathematics in learning to use, implement, and revise a lesson.

The contrast between Heidi's and Tara's implementations - and subsequent noting of the richer learning by Heidi's students - indicates that opportunities for cultural pit-stops must be infused into the lessons and must be taken up and used by teachers. This provides further support for Wolcott's (1982) notion that culture must be taught and suggests that it must also be explicit in the lesson. A shared problem-solving approach to mathematics lends itself to the Chamorro

culture because the nature of the culture is community oriented. By infusing aspects of the culture into the lessons and framing the lessons in a community setting, the subtle relationship between the culture and the mathematics can be strengthened.

5. Conclusion

The goal of this study was to understand what happens when teachers collaborate to implement a mathematics unit designed to be culturally relevant and problem-solving rich. I believed that the teachers involved in the project would be positively affected and that they would gain some degree of acceptance of the new unit and the unit would be successfully implemented.

The relationship between culture and mathematics is nuanced. In the grade 1 case presented here, culture framed the context of the lessons but the culture may never have been referred to again after the first day when the story was read. Note that only the teacher who strongly identified with the Chamorro culture, Heidi, felt compelled to highlight the cultural components of the story. Tara, who had lived on the island for many years and called it her home, felt no such compulsion because she assumed that since her students were from the place, no elaboration was necessary. This implies that if more blatant cultural pit-stops are desired then the lesson must be written explicitly to address assumptions that might be made (e.g., as in Tara's case). I had expected that as teachers in an indigenous context (the Pacific island of Saipan), the teachers would understand and live the ideals of respect, reciprocity, and responsibility. While I was not mistaken, this assumption did not translate into the details of the lesson. For future research projects that include culture embedded in the lessons, the plans must be explicit for teachers as to where the cultural pit-stops could occur and provide scaffolds for teachers about how to manage them.

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