Finding a Good Fit: Using MCC in a "Third Space"

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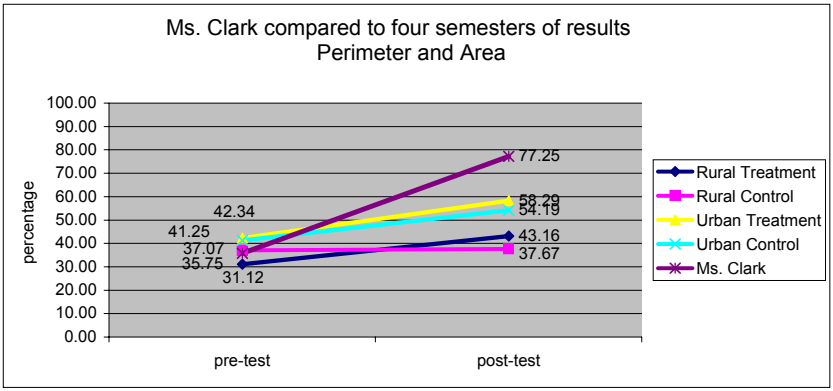
Math in a Cultural Context (MCC) is based in traditional Yup'ik cultural values and ways of knowing and representing the world, which provide access to math concepts through hands-on exploration and active problem solving. This case illustrates how a novice and outsider teacher successfully implemented MCC in a classroom with predominantly Yup'ik students, who are from a school district that has been a lower scoring district on state and national tests. The success was evidenced in students' high gain scores on pre- and post-tests for the *Building a Fish Rack* module, and their out-scoring of all other student groups involved in the implementation of this module. The case explores the factors that contributed to these students' academic success and focuses on the key elements underpinning these factors: (a) the relationships that developed between teacher and students and (b) the co-creation of a "third space" for learning by students and teacher.

Introduction

Stacy Clark was a novice teacher who had taken her first teaching job in rural Alaska in the village of Ilutuq after completing a post-baccalaureate teacher certification program at the University of Alaska Fairbanks. Ms. Clark first came to our attention because the students in her multiage class made high gain scores on pre- and post-tests for the *Building a Fish Rack* module. In fact, her students out-scored all other student groups involved in the implementation of the *Building a Fish Rack* module. Table 1 illustrates the average gain scores on pre- and post-tests for *Building a Fish Racks* across four semesters for all students by block, rural and urban treatment and control groups, and how these compare with the gain scores for Ms. Clark's students. Ms. Clark's students gained 41.50% as compared to gain scores of all students in urban control (12.94%), rural control (0.60%), urban treatment (15.95%) and rural treatment (12.05%). As the chart indicates, not only did Ms. Clark's students have the highest gain scores, but also her students' absolute scores were better than all students in all urban and rural treatment and control groups. While there have been other teachers in other trials with MCC modules that have outperformed the students across all four blocks in gain scores, these high performances have not necessarily been in post-test

Table 1
Comparison of pre- and post-test scores between Ms. Clark's students and all students by block



scores, which clearly makes Ms. Clark's students' performances highly anomalous and compelling.

The high performance of students from a school district that has been one of the lower scoring districts on both state and national tests of achievement made us want to examine this case more closely for the possible factors contributing to these students' achievement. Thus, this case describes and discusses those factors and how they influence the success and academic growth of these students. Further, as we unpacked these various factors, it became evident that the relationships between Ms. Clark and her students were a key element contributing to her students' academic success, and consequently, the development of these relationships played an integral role in understanding the factors in this case. Thus, central to this case is the analysis of the development of a dynamic learning environment based in mutual respect and trust, which was co-created by Ms. Clark and her students.

Theoretical Framework

A conceptual framework built on three related theoretical perspectives guides this case. The first perspective, sociocultural theory, provides the overarching theme guiding this project. Specifically, we draw from the theory of Vygotsky (1978, 1934/1987), which stresses the social nature of all human activity and situates learning within social contexts. Thus, learning takes place in the context of collaborative activity, which involves multiple cultural resources that work together to create ranges of potentials within zones of proximal development that emerge through group interaction. This perspective on learning through collaborative activity, referred to as *joint activity,* is viewed as a socially mediated process of co-participation and co-learning (Gutierrez, Baquedano-Lopez,

Alvarez, & Chiu, 1999). Such a view of collaboration suggests a transactional (Rosenblatt, 1978) event takes place as learners engage in the activity, such that the co-constructed learning becomes the co-created "poem."

Further, within a Vygotskian perspective, human development relies on tools and signs[1] as mediators of thought processes. The cultural values of a group are represented in the sign systems they employ to assist them in human activity, communication, and the formation of social structures and relationships. Thus, the extent to which individual members of cultural groups internalize the values of their group's cultural way of knowing depends on the degree of consonance with the cultural tools that serve to mediate their development (Smagorinsky, 1995). According to Smagorinsky, "Tools enable meaning construction when they are sanctioned by the cultural environment of learning, are recognized by the learner as tools, and are used volitionally by the learner" (1995, p. 195). In this case study, this notion of consonance is integral to the socially co-constructed learning environment co-created by Ms. Clark and her students.

The second perspective stems from the notion of "funds of knowledge" (Moll, 1992; Moll, Amanti, Neff, & González, 1992). Funds of Knowledge are described as "the essential bodies of knowledge and information that households use to survive, to get ahead, or to thrive" (Moll et al., 1990, p. 2). According to the funds of knowledge perspective, students are a key aspect of a teacher's knowledge base that can be tapped into to enhance classroom learning. This requires that teachers learn firsthand about the experiences and knowledge of their students and their families, rather than relying on generalized notions of "the culture of these students." In the context of this study, the funds of knowledge are situated not only in the community members' cultural practices and subsistence lifestyles; they are also embedded in a culturally based math curriculum, Math in a Cultural Context (MCC), which is based in traditional Yup'ik cultural values and ways of knowing and representing the world. This case illustrates the confluence of these funds of knowledge and one teacher's ability to bring together and transform the knowledges into meaningful mathematical activity.

The third perspective draws from the theoretical construct of "third space," which has been interpreted in various ways that are situated in diverse social, cultural, and political contexts (Lipka et al. 2005; Moje et al. 2004; Gutierrez, Rymes, & Larson, 1995). This term is often characterized by its in-betweenness. Our approach to third space situates it between the culture of traditional Western notions of knowledge and schooling and the ways of knowing, interpreting, and interacting of the heritage cultures of indigenous peoples (Webster & Lipka, 2004). We further suggest that a third space can be created through a culturally based curriculum such as MCC, which brings academic content knowledge into dialogue with indigenous cultural knowledge that has historically been left outside the schoolroom door. In this case, we apply the notion of third space in two ways: (a) through math content MCC creates a third space in which a dialogue between academic content knowledge and indigenous knowledge can

take place; and (b) through pedagogy and cultural resources. The learning community co-created by Ms. Clark and her students brings together the students' cultural backgrounds, the traditional social and academic norms of schooling, and the cultural background of a teacher/outsider, schooled in nontraditional educational contexts.

In addition, we suggest that a third space was co-created by Ms. Clark and her students as they negotiated and co-constructed new cultural norms in the classroom. The development of new forms of interaction and communication between Ms. Clark and her students, which may be construed as antithetical to traditional Yup'ik cultural values and norms of communication, are similar to what Paradise (1994) describes as "spontaneous cultural compatibility" (p. 60). In Paradise's case of a new school principal who was also a cultural outsider in the indigenous Mazahua community, the notion of third space is created spontaneously as this principal and the Mazahua students negotiate a new way of interacting together, which is at first glance incompatible with Mazahua cultural values and communicative norms. However, as demonstrated in both cases, the potential tension of the apparent dissonance with cultural values and norms was eased and replaced with a new set of norms that were co-created by the students, teacher, and principal. Thus, both cases demonstrate the fluidity of this conceptual construct of third space, which is continually being negotiated and renegotiated, constructed and reconstructed. Therefore this third space can be viewed as parallel to Vygotskian notions of consonance that facilitate the co-construction of meaning and the mediated learning that occur within the "zone of proximal development" (ZPD) (Vygotsky, 1978).

In this article we build on these theoretical perspectives by examining the various factors that enhance students' math performance as these factors emerge through the teacher's use of MCC and the funds of knowledge of her students and their community. Ms.Clark uses these to co-create a third space for teaching and learning with her students.

Methodology

Data for this case were collected from a variety of sources: videotaped lessons, formal and informal teacher interviews, classroom observational field notes, phone and e-mail debriefings with teacher, and student work and journals. Analysis of data occurred in various contexts: (a) research team video analysis sessions; (b) teacher and case researcher's video analysis sessions; and (c) researcher's discourse analysis of lesson and interview transcripts. The research team video analysis was conducted using a "fidelity of treatment" protocol designed to examine specific incidences of math and cultural content and pedagogy evidenced in the lesson (e.g., use of math vocabulary, collaborative work, student-driven questions, conceptual rather than procedural development, etc.). Additional videotape analysis was conducted in collaborative sessions with the teacher (Ms. Clark) and case authors. These analyses were focused on identifying and examining emerging themes, that is, categories generated from

high frequency of occurrence of key words or phrases, math content, nonverbal communication, participation structures, etc. Further analysis of video segments was conducted by a group of Yup'ik educator consultants and university project researchers. This analysis provided a cultural lens, which helped unpack different aspects of communication between students and teacher and the underlying cultural values inherent in Yup'ik views on teaching and learning. Finally, a critical discourse analysis (Carspecken, 1996; Fairclough, 2003) was conducted, using the transcripts and the emerging trends and categories from the analysis sessions and transcripts of lessons and interviews. In this analysis, terms were analyzed for the range of meanings of the official/public construction (Fairclough, 2003) of a word, term, or concept (e.g., math communication) and the private construals (e.g., math communication as nonverbal gesturing to signify angles, diagonals, etc.) that are manifested across social and cultural contexts (Webster & Silva, 2004; Silva & Webster, 2004). Additional reconstructive analysis (Carspecken, 1996), which is based in Habermas' (1987) notion of communicative action, was used to explore the validity and identity claims made by students and teacher and the influence these claims had on the co-construction of a new cultural norm in the classroom.

The results of these analyses are presented in the following sections. In the first section, we describe the overall pedagogical philosophy that underlies Ms. Clark's approach to inquiry-based instruction. Next, authors Wiles and Civil examine the characteristics of Ms. Clark's instruction that appears to have been a good fit, both in math content and pedagogy with the theoretical underpinnings of the fish-rack module. In the final section of the paper, author Parker Webster discusses how Ms. Clark and her students co-created a third space as they negotiated new sociocultural norms for communicating, which fostered the transformation of potentially adverse effects of cultural incongruity between teacher and students into a collaborative learning community based in relationships built on mutual respect and trust.

Establishing a Culture of Inquiry

Ms. Clark joined the study in her second year at Ilutuq. As a new teacher in a rural village, she felt particularly isolated and without the support generally available to novice teachers in urban schools with strong professional development networks. Upon her arrival to the village school, Ms. Clark was given the Alaska State Standards as her only curricular guide. However, it was no surprise that Ms. Clark was drawn to reform-oriented approaches to mathematics instruction that emphasize problem solving and inquiry. Ms. Clark's undergraduate degree was in outdoor education, and she was a product of nontraditional schooling that employed inquiry-based learning as the curriculum. Commenting on her use of this approach in her classroom, she stated, "The kids love to do … I don't know how much this is necessarily culturally … but they love to do, they want to inquire." Without direct supervision from the district, she was given a great deal of freedom to experiment with these teaching methods.

Because her students were not familiar with this method of teaching, one of her priorities was to establish norms in the classroom that were conducive to inquiry-oriented instruction. According to Ms. Clark,

> Inquiry was very difficult at first because they were not risk takers. We did spend a lot of time setting that up, that it is okay to get something wrong. It doesn't have to be right; it is how they get there. Looking at different solutions and different things, that there is not one right way to do something.

Whenever possible, she had the students take ownership of their own ideas. When mathematics vocabulary was introduced, Ms. Clark felt it was important that the definitions come from the students, even if they were not the same as what would be in the textbook. She communicated this belief to the students during class. In one episode where the students were tasked to write down the definition of a rectangle, she notices the students are unsure what to write. In response, she says to the students, "you have a picture of it. Make it up. Is there a right or a wrong here? You can't write down the wrong meaning if you write down what you see."

Reflecting on this approach to teaching, Ms. Clark said,

> I received my teacher education here in Alaska. We hear a lot of negatives about Alaska Natives, that kids don't care, that parents don't care, that kids are hooligans and so on. I just wanted to leave that behind; I didn't want to take this with me [when she moved to the village to teach]. So, I really thought about developing a classroom environment and how important that was. It dawned on me that no one made these kids go to school; they come of their own accord, so I wanted to give them a reason for coming to school, I wanted them to own their education; I wanted them to show up and do their best.

Ms. Clark used these principles to guide her instruction.

Math Content and Culturally Relevant Mathematics

The module that is central to this paper is *Building a Fish Rack: Investigations into Proof, Properties, Perimeter, and Area* (Adams & Lipka, 2003). The central mathematical themes revolve around examining properties of shape, using these properties to develop ideas about proof, and examining ideas of measurement, perimeter, and area of shapes. Throughout the module, the activities emphasize collaborative group work and active involvement of the students.

One of the early activities is concerned with engaging students with investigating properties of rectangles. As groups, the students are to establish a rectangular base for their fish rack and demonstrate whether the shape they have made is or is not a rectangle. In this process, the students must decide what the properties of a rectangle are and how to show that the shape they have created possesses these properties. The activities are intended to be student-directed, involving students' exploration of these ideas rather than having a teacher present them to the student. In this activity they are not only developing their knowledge of shapes and their properties but also using these properties to make reasoned arguments.

The cultural context of the modules is treated with as much importance as the mathematics content and is not simply used as a brief segue into more traditional mathematics activities. Rather, the students engage in extensive investigations about Yup'ik culture. The central cultural practice in the module under discussion is building a fish rack, which is integral to the subsistence lifestyle that many Alaska Natives live. The first four activities of the module establish the cultural and ecological backdrop through discussing fishing and the life cycles of salmon. After the context is established, the students explore building a fish rack. In the module it is suggested that an elder in the village first demonstrates this for the students. The elder's approach to making a rectangular base is mathematically rich even though this approach may not be what academically trained people would necessarily use. For instance, the elder might establish the rectangle in informal ways, using body measures or other nonstandard forms of measurement. At the same time, ideas that are traditionally identified with school knowledge are apparent, such as identifying the location of the corners and center of a rectangle. The elder also brings a cultural perspective about how the rectangular fish rack is formed that might not traditionally be identified as being mathematical (e.g., orienting the fish rack toward the wind so the fish will dry faster). The module then builds off of elders' knowledge by integrating the Yup'ik language and identifying the traditional Yup'ik names for parts of the fish rack.

Thus, this module blends a student-centered approach to learning with a cultural perspective to create a learning environment where students participate as a community of learners (Rogoff, 1994). From this perspective, "students learn the information as they collaborate with other children and with adults in carrying out activities with purposes connected explicitly with the history and current practices of the community" (p. 211). Ms. Clark echoed this when she spoke about the modules: "the environment was there, they were safe to explore, they were safe to inquire. It used the cultural components … from their environment. It was designed around fish racks, and these kids know fish racks. They are everywhere in the village. They can picture that and we really got down to the math." From her perspective, establishing the cultural connection provided access to the mathematics content. Many of the activities in the module, though rooted in an authentic context, develop into discussions of mathematics that would not typically exist outside of a school setting. One might argue that the modules represent more closely what Lave and Wenger (1991) would refer to as a "learning curriculum," which consists of "learning resources in everyday practice *viewed from the perspective of learners*" (p. 97). This is opposed to a "teaching curriculum," where learning is identified only through the instructor's activity without regard to the context in which the learning is taking place. This is not to say that Ms. Clark's participation in the classroom community did not play a key role. In the following sections we will examine the factors that supported the implementation of the module.

Mathematical Implementation

The lessons that we will discuss draw from the activity mentioned above, where students are asked to establish a rectangular base and to use their knowledge of the properties of rectangles to reason whether their shape is or is not a rectangle. Ms. Clark began with the framework of the activity as it was written in the module and continued to develop these ideas over three class periods. She implemented the fish rack module in a way consistent with her belief in the importance of developing a culture of inquiry in the classroom. We have identified two critical components that were central to her developing this culture. First, Ms. Clark devoted a significant amount of class time to open-ended exploration. The tasks that the students engaged in were suitably complex so that multiple solutions and strategies were possible. As the students began to work, she paid attention to the students' actions and acted in ways to make sure the complexity of the task was maintained. She had high expectations for her students with regard to their ability to reason and communicate their thinking. Second, Ms. Clark developed a learning environment in the classroom that was largely student-centered. She frequently made use of her students' input to guide and direct her instruction, which was consistent with her belief that the students should take ownership of the mathematics with which they are engaged. While Ms. Clark made extensive use of student input, she played a critical role in guiding the students toward more sophisticated mathematical ideas by requiring them to critically examine their statements and become more precise in the way that they talked about mathematics.

Complex Open-Ended Exploration

One of the central characteristics associated with students' learning in a mathematics classroom is the level of cognitive demand inherent to the mathematics task that is being implemented (Stein & Smith, 1998). Henningsen and Stein (1997) characterize the cognitive demand of a task as "the kind of thinking processes entailed in solving the task as announced by the teacher (during the set up phase) and the thinking processes in which students engage (during the implementation phase)" (p. 529). High-level tasks are those that require non-algorithmic thinking and focus the students' attention on mathematical concepts and relationships. These tasks also require students to tap into their own experiences and use these. Several factors are associated with maintaining cognitive demand during a task's implementation: (1) scaffolding of student thinking, (2) self-monitoring of one's own progress, (3) modeling of high-level performance, (4) sustained press for justification and explanation, (5) building on students' prior knowledge, (6) frequent conceptual connections made, and (7) sufficient time given to explore (Stein, Smith, Henningsen, & Silver, 2000). We will examine the extent that these factors were observed in Ms. Clark's instruction.

The Classroom Case

In the initial stages of implementing the module, Ms. Clark followed the instructions closely. For example, in an initial outdoor activity, students were to use string to establish a rectangular base that was approximately 9 by 12 feet. Students worked in groups to discuss what they noticed about the rectangle. While some students were beginning to test theories about properties of rectangles, such as using body measures to measure the sides and diagonals or establishing the center point of the rectangle, it became clear to Ms. Clark that other students were more focused on making the dimensions of the rectangle correct rather than focusing on the properties that made it a rectangle. In addition, the large scale of the exploration resulted in a number of inaccuracies of measurement that limited the students' abilities to reason about whether the shape was a "perfect" rectangle. Ms. Clark addressed this issue directly in the following day's lesson:

Ms. Clark:	You looked at it and you said, "yeah, those were 90 degree angles," and it all works and what happens … then I measured the diagonals and what happens? It was as if someone hit you in the head. You guys were bummed; you had it all perfect. And who said, "it's okay, it's almost exact?" Is it okay, it's almost exact?
Students:	[yes and no responses from the class, yes being predominant]
Ms. Clark:	It is okay to be almost exact?
Students:	[yes and no responses, no being most predominant]
S:	It is approximate.
Ms. Clark:	Right, but then we would put that this is approximately a rectangle. What were we looking for? Were we looking for approximately a rectangle?
S:	Trying to be exact.
Ms. Clark:	There was no messing around. So we had to have something that had what? Let's go over this again.
[Teacher goes to board, begins writing students' responses.]	

In this episode, Ms. Clark was trying to turn the direction of the discussion toward what properties make a "perfect" rectangle. Although it is impossible for a physical representation to be exact, turning the discussion in this direction focuses the students' attention on a mental image of a rectangle. This is a key step in developing advanced geometric reasoning (Clements & Battista, 1992).

Rather than ending the exploration, Ms. Clark had the students continue their investigation indoors by using masking tape to construct a rectangle at their tables. After the students placed their tape to establish the location of the vertices, students began exploring the rectangle in more depth without verbal prompting from the teacher. Some students began to establish the center of the rectangle, others used string to measure off the diagonals, and still others used a book to gauge how accurate their angles were. As Ms. Clark moved from group to group, she monitored the extent that the students were thinking about properties of rectangles. At one instance, she observed that some students were tracing their folders rather than using the folders as tools to reason with. Her responses to the

students illustrate how she directed her students toward thinking about ideas in more complex ways.

Ms. Clark: Oh! I was hoping you were going to keep going with what you were doing here. Because all you are doing now is outlining the book. That is now really using what you know about rectangles except that you know the book is a rectangle.
Ms. Clark: [addressing the class] So, I see people have taken their books and decided that they wanted to just outline their books. Why? Let's look at it that way then? Why have you done that? Why use your book?
S: Because it is a rectangle.
Ms. Clark: Yeah, and what about it makes it a rectangle, Glenda? Why do you know that it is a rectangle?

Ms. Clark redirected the students to continue thinking about the central mathematical ideas of the lesson. At the end of the day's lesson, the students had laid out their rectangles and had done some initial reasoning about its properties, but they had not had to communicate or refine their thinking. In the following lesson, Ms. Clark shifted the lesson from making a rectangle, which she observed the students could easily reduce the complexity, to focus instead on reasoning how they know they have a rectangle.

Ms. Clark: Now, if I'm a cop and I'm trying to prove that someone is guilty of something, what am I going to look for?
S: Evidence.
Ms. Clark: Evidence. Of what? Let's say somebody breaks into our classroom and takes our Tootsie Roll stash.
S: Fingerprints?
Ms. Clark: What are we going to look for, Jerry?
S: Fingerprints.
Ms. Clark: And what else?
S: Evidence.
Ms. Clark: Evidence.
S: Tracks.
Ms. Clark: Tracks. How they got in.
S: The tool they used.
S: Who has a lot of Tootsie Rolls?
Ms. Clark: Who has a lot of Tootsie Rolls around town? Yeah. Well, you're going to find, now, do you just get stuck on, "I'm looking for three pieces of evidence and that's it."
S: No.
Ms. Clark: No. That's not going to help you solve a crime. So you're going to solve a crime, and you are looking for evidence, proof of the crime. And the crime is: that the shape you have created is not a triangle. I mean, I keep doing that, I mean a rectangle.

This episode illustrates the beginnings of higher-level cognitive demands, because there is no prescribed way to work through the problem. As the case develops, the evidence clearly shows that the students continue to make progress toward meeting the high-level demands of the curricular task. In the above

instance, the students had to form connections between the concepts that they understand about the features of shape. The teacher's talk used typical academic mathematics vocabulary and sentence structure (e.g., your task is to prove that what you have is a rectangle), but she used scaffolding (such as framing it in terms of evidence and connecting that with students' understanding of evidence) to help her students understand this academic talk. She also addressed an important aspect of doing mathematics: They had to prove that the shape was a rectangle. This meant that it had to be **exactly** a rectangle, not **almost** a rectangle. This is an important distinction because for everyday purposes, "almost a rectangle" may be all that is needed, yet from a mathematics point of view, that is not enough (see Kahn & Civil, 2001, for another example of the interplay of everyday and school mathematics in the context of maximizing area for a garden). By introducing the notion of proof into the discussion, Ms. Clark kept the activity focused on reasoning and established the expectation that this reasoning must be communicated to others. She realized that this would be a challenge for her students and would require extra effort on their part.

Ms. Clark: Carol, do you mind if I pick on you for a minute? Do you remember, Carol, what happened when you were making that eight-faced object? What happened when you started?

S: I was stuck in only one way.

Ms. Clark: You were getting stuck on only … in her brain she only had this one way to do it, because we had made cubes before and she was stuck in cube mode. Now you guys weren't even playing around with diagonals and stuff, but I want you to step out of your head and try all different ways that you can prove this evidence. We are looking for evidence, these are … this is what we are trying to prove.

Many tasks that are associated with high levels of cognitive demand may engender a feeling of frustration among the students. Ms. Clark was aware of this but still held her students to high expectations. Near the end of the third day's lesson, she said to the students, "I don't want you guys to get frustrated. I just want you to keep trying. I know that it can be … some people are starting to get frustrated, but that is okay. Carol, when faced with a challenge, what do we do? Try and try again." Note she was trying to keep the students working at high levels, she was also trying to establish a safe environment where her students would continue to think, even when they were up against obstacles.

Student-Centered Instruction and Ownership

Not only did Ms. Clark focus on keeping the task suitably complex, she also organized her instruction around her students' own thinking. She consistently used the beginning of class as a platform on which the students could display their thinking. Before beginning the module outside, Ms. Clark engaged the students to discuss their thinking about what a rectangle is. During this time, Ms. Clark was acting primarily as a facilitator and recorder, trying to bring out her students' thinking. She outlined this task as one of constructing a definition for a rectangle.

She instructed to students to "write down the meaning, set it up like in the dictionary. Write the meaning of the word, just like in the dictionary. What is special about this rectangle? If I walked up to you and I had no idea of shapes, I come from a completely circular world, I am the blob, explain to me what a rectangle is. What's a rectangle?"

As she walked around, the students wrote their ideas in their journal. Ms. Clark continued to question them as they worked.

S: I'm finished.
Ms. Clark: Is that all it has? If I found an object ...
S: [inaudible]
Ms. Clark: OK, how many sides? Is that important to know? Could we make a five-sided rectangle?
S: No.
Ms. Clark: No, because then it would be what?
S: A pentagon.
Ms. Clark: A pentagon, so it is important to know how many sides there are, right?

Ms. Clark's emphasis was to give the students a voice and to gauge their thinking about the mathematical ideas. Though she did engage with the students and offer support, at no time did Ms. Clark tell the students what a rectangle is or what properties they should be looking for. Instead her role was more collaborative than directive, even when the ideas that the students offered were not mathematically correct.

Ms. Clark: If it is exactly a rectangle, there are a few things we know. What are they? Andrea, what are the things we know about a rectangle?
S: A rectangle?
Ms. Clark: A rectangle.
S: It has four sides.
Ms. Clark: Nada, can you tell us anything else about the sides?
S: Two are short and two are long.
Ms. Clark: Okay, so two are shorter and the other two are longer.
S: Yes.

While the prototypical rectangle has unequal sides, this definition precludes the possibility of a square also being a rectangle. Ms. Clark's willingness to leave this statement unchallenged was consistent with her stated belief that the mathematics should come from the students, even if the textbook definitions are not produced. That is not to say that Ms. Clark took a passive role when probing for student input. Even though she wanted the ideas to come from her students, she also wanted to push them to express themselves in more precise ways.

Ms. Clark: All right, Deb, can you tell us anything else about a rectangle? … Brian?
S: It has 90-degree angles.
Ms. Clark: It has 90 degree angles, where? In the middle? Where does it have 90 degree angles? Be specific.
S: In the corners.

She continued to press for precision as the discussion continued:

Ms. Clark:	Could anyone tell me anything else about a rectangle?
S:	It has parallel lines.
Ms. Clark:	Oh, so what, these lines are parallel? [points to two adjacent sides.] Which lines are parallel?
S:	The ones across from each other.
Ms. Clark:	So what would we call it if they are across from each other? What would we call that? Can anyone come up with a word we could use for something that is across from each other?
S:	Next to?
Ms. Clark:	They aren't next to each other are they? What are they? … What do we want to say? Linda, help me word that [pause]. Come on guys, help us word that.
S:	Sides are parallel to each other.
Ms. Clark:	But this side here is not parallel to that side [points to two adjacent sides]. So I could say, "well then, I don't have a rectangle since these sides aren't parallel to each other." [Draws four parallel line segments on the chalkboard.] If all the sides were parallel to each other then that would be my rectangle.
S:	The short side and the long side are parallel.
Ms. Clark:	Keep going, you are getting it. We need help from everybody here. We know what we are trying to say but we want to come up with a way that is really good evidence, so that when we take it into court, they aren't going to throw it out because of shoddy evidence. How are we going to word it, Leroy? I agree with you, I agree with the concept.
S:	Both short sides and long sides are parallel to each other.
Ms. Clark:	Maybe we need to make two statements, maybe we can't do this in one statement, it is too big of a mouthful. Lets try it, Glenda. Both…
S:	Both short and long sides are parallel to each other.
Ms. Clark:	Okay both … so you are saying this side is parallel to that side [points to a short side and a long side of the rectangle].
S:	No!
Ms. Clark:	Thomas, you were trying.
S:	Both short sides are parallel and both long sides are parallel.

At the same time that she was pushing for greater precision, she was also continuing to reinforce the culture of the classroom as a safe environment where students were comfortable offering their own thinking. In the above episode, Ms. Clark encouraged and supported her students to keep working at it. She also emphasized that it was the job of the entire class to try to work this issue out. This type of expectation for co-construction of meaning through joint activity characterized Ms. Clark's approach to teaching and was integral to her pedagogical philosophy. The next section discusses how this safe and yet challenging learning environment was co-created from seemingly disparate cultural norms, opening up a "third space" for learning.

> Ms. Clark is moving around among the various groups as they are working on the task of coming up with proofs for a rectangle. She stops to help a group, offering suggestions. One of the Yup'ik educators says, "She told them, no, that wasn't the way to do it. She is telling them how to do it." Another says, "She has the ownership [of the lesson]." As she moves from table to table, Ms. Clark glances around the room and observes a student who is using something other than the string to measure his rectangle. Suddenly, she says, in a very loud voice, "Brian Andrew, 20 push-ups right now!" Brian looks up, with a grin on his face, then, he gets back to the activity with his group. One of the Yup'ik educators in the video analysis group audibly gasps while physically cringing. She gestures, pushing away an imaginary figure with her two hands. Another Yup'ik educator says, "I wouldn't want to make mistakes in her (emphasis) class." One observer of the videotape commented: "Look at the kids to see their reaction, and pay attention to your reaction and what accounts for the difference. I think that is the key to this." Brian has made no effort to get up and do 20 push-ups; he is right back working with his group (Excerpt from Video Analysis Field Notes 3/22/2005).

Earlier in this article, we provided examples illustrating ways Ms. Clark provided opportunities for students to own and direct their learning through inquiry. Further, from the videotapes and classroom observations, we interpreted the interactions between students and teacher as flowing with an ease that usually characterizes a strong, collaborative learning community that has been working effectively together for a period of time. It seemed an illustration of what Ms. Clark called a safe community. So what was causing the apparent schism of interpretation between the Yup'ik educators and the other observers watching the videotape?

The reactions by the Yup'ik educators may be explained by the apparent cultural dissonance between Ms. Clark's manner and interactional style and the cultural values and communication style of the Yup'ik educators taking part in the video analysis. However, the evidence presented in the above examples suggests that a high level of trust and mutual respect existed between teacher and students. This sense of relationship and the students' high gains on the test scores seem to indicate that this dissonance between the cultural norms of the teacher and her students had been brought into consonance through a negotiation of the cultural tools and ways of interacting that were sanctioned and used volitionally by the members of the learning community. This kind of negotiation and co-creation of a new cultural consonance, based in relationships of trust, seems very similar to the notion of "spontaneous cultural compatibility" that existed in the Mazahua school community described by Paradise (1994). The parallel nature of the two cases, the one presented in this article and Paradise's case of the new principal of a primary school in a Mazahua community in a Mexico state, provides a framework for discussion about how new cultural norms can be co-created from existing norms that may be in tension with each other. In the following section, the similarities between the two contexts are presented. Next,

the common themes that support the notion of co-creating a culturally consonant, "third space" learning environment are described.

Achieving Consonance in the Third Space

The similarity between Ms. Clark's case and the case of the Mazahua principal begins with the notion of insider/outsider. Both Ms. Clark and the principal were outsiders, living in a rural village and working with children from an indigenous culture. The rural context of the cases gave this insider/outsider dualism a sharper contrast due to the cultural homogeneity of the village population. This insider/outsider dualism, coupled with a rural setting, also played a role in the shaping of teachers' perceptions about the students and community. For example, in the Mazahua case, Paradise (1994) notes that outsider teachers claimed that they were "unaware of the existence of cultural differences" and tended to explain any differences manifested in students' behavior as caused by the rural setting or influence of economic resources (p. 61).

In Ms. Clark's case, as she previously stated, there were generalizations about the negative attitudes and bad behaviors of Alaska Native students in rural Alaska schools that she wanted to "leave behind." In many cases, these generalizations were generated by outsiders who didn't understand cultural norms of communication, which can differ across the cultural and linguistic groups within Alaska. For example, a Yup'ik student's silence when called upon by a teacher might be construed as being disengaged or having a negative attitude, when in fact the student may not want to stand out in the group by "showing off" and giving the answer. This insider/outsider dualism was further defined in each case by the significant differences in accepted cultural norms of interacting. Both the principal and Ms. Clark exhibited similar interactional patterns that were contrary to their students' culturally based modes of interacting and communicating. Ms. Clark's manner, like the principal, could be construed as confrontational (Paradise, 1994) and even adversarial, delivering commands in a loud voice, as in the above example when Ms. Clark orders Brian to do 20 push-ups. Ms. Clark also consistently called on students in class, which is contrary to Yup'ik norms of interaction and communication (Lipka et al., 2005). However, for both the Mazahua principal and Ms. Clark, this cultural dissonance was mediated by three common themes that work together to create a new cultural consonance within the learning environment.

The first theme is valuing students and the unique abilities and knowledge they bring with them to the classroom. Both Ms. Clark and the principal of the Mazahua school showed an "appreciation of their [students] intelligence" (Paradise, 1994, p. 63). In Ms. Clark's view, each student in her class had different strengths that contributed to and enhanced everyone's learning:

> These kids are really bright. Like Matt and David they are computational whizzes. Give them a problem, any problem, and they will work it out. The other kids know that if they get stuck and need help with how to do a problem, they can go to Matt or David for help. It's the same with Angie …

> she can really write great stories. She's a good reader and writes all the time. The kids recognize each other's strengths, they know who is good at what, and they learn from each other.

Ms. Clark's recognition and valuing of their intelligence, coupled with her high expectations for her students created a strong learning environment in which students could excel at their own pace and in their own unique way.

The second theme is student ownership and autonomy. In both cases, the students were not "*subjected* to authority, rather authority was allowed by the students, granted even, because it was shown to be legitimate on their terms" (Paradise, 1994, p. 64). The same held true for Ms. Clark's classroom, and it seemed that in both instances the students operated from a set of "rights and responsibilities" (Lipka, 1991, p. 216) that were characteristic of the social organization of a Yup'ik classroom composed of Yup'ik students and a Yup'ik teacher. The notion of ownership and autonomy in Ms. Clark's classroom literally began at the door.

> At the very beginning, the students knew this was *their* classroom. It was a safe space where they could come in, be themselves … where students could enter to learn and have fun learning and feel safe about taking risks. I asked my students to leave their anger outside.… We are a family and we need to respect and trust each other. I told them that everything in the room belongs to them. … That is why they take care of the things here.

Students could always be found in their classroom before and after school, listening to music, reading, writing, drawing, working on the computer, or just hanging out. This sense of student ownership of the classroom is also evident in the way the students freely move around and use the space. For example, during one of the fish rack lessons, while Ms. Clark is at the front board, recording student responses, two students begin drawing a rectangle on the whiteboard at the back of the class. One student draws a rectangle and silently marks the right angles at the four corners with a semicircle. The other student takes over, drawing diagonal lines from each corner circling the center point. What appears to be happening in this silent exchange is that the students are demonstrating their understandings about the properties of a rectangle. The activity occurred without either student asking Ms. Clark's permission and without any direct command by Ms. Clark to demonstrate proofs of a rectangle for the class. In other words, the students practiced their autonomy in a learning event that used a classroom artifact (whiteboard) that is generally within the domain and under control of the teacher. They did this without any formal direction or questioning because they knew that the classroom and its artifacts were theirs to use.

Student ownership was also evident in the ways they demonstrated their knowledge and learning through their interactions with each other and with Ms. Clark. As stated previously, Ms. Clark felt it was important that the definitions come from the students and she would only write "their words, what they say it means" on the board. For example, when students are discussing properties of a rectangle, as described in a previous example in this article, the concept that

the module emphasizes is that opposites of a rectangle are *parallel*, but the students used the word across. According to Ms. Clark, "The module stated that opposite sides are parallel but the students gave me across, but the module wanted them to say *opposite*. But I realized that it is more important to define these properties in their words."

Ms. Clark also understood and encouraged the nonverbal communication that students used to demonstrate their understanding of a word. For example, in the discussion of the notion of parallel, using the word across, one of the students has his hands in a *cross*, showing Ms. Clark that the sides across from each other are parallel. Ms. Clark said:

> It is stuff like this is why I think that they got it. It is the setup such as the notion of cops and proof that they can understand instead of the more abstract words used in the module, such as *proof* and *conjecture*. They are really solid in their understanding of what their task is. I don't do a lot of dictionary work. I back off and let them come up with their own working definition. I think that was what was so important. They were not being told that parallel lines were opposite each other, because they understood the concept using the word across. I tell them don't write down anything on the board, unless they understand it.... They write down what *they* have come up with. If they don't get it, we need to talk it out until it comes out in a way that everyone understands and can write it down.

Thus, this collaboration between the students on the meanings of vocabulary words is generated from their ideas, which makes sense to them. Rather than writing down a textual definition, which they may or may not understand, the students take ownership of the word and concept and create their working knowledge of it as Ms. Clark, the scribe and "scaffolder," writes it on the board. Thus, the notion of student ownership encompassed both the physical sense—it was *their* classroom—and the cognitive and metacognitive sense. Ms. Clark respected her students' abilities for meaning making and encouraged students to take responsibility for their own learning, allowing the construction of meaning to emanate from the students and not from her direct instruction.

The third theme is what those in the project have come to call "the fourth R," which refers to the relationships between students and teacher or principal and among the students themselves. This theme is the foundation for the first two themes. Without the trust and respect that pervaded both learning communities, Ms. Clark or the Mazahua school principal might not have recognized and honored the knowledge and experience that their students brought with them, and therefore, the students' autonomy and ownership of their learning would have been seriously threatened.

Ms. Clark first began developing this relationship of trust built on mutual respect outside of the classroom as she and her students spent time on the river every day during the first week of school. The river was their turf, a place where the students were the experts. According to Ms. Clark, she wanted to learn about where they spent most of their time and where they could share their knowledge with her as well as the rest of the students in the class. It was a place in which

each person could be a contributing member of the learning environment. The river provided a geographical context for the theoretical construct of a third space that offers opportunities to blend community and culturally based knowledge with school-based literacies. Time was spent playing trust or teambuilding games, talking about community subsistence activities, listening and observing the environment, drawing, writing in journals, and just having fun. These times set a tone of familiarity and familial relationships that were carried back into the classroom. This "tradition" occurred each of the three years that Ms. Clark was in Ilutuq and became an integral piece that contributed to and sustained the new cultural norms and ways of interacting co-created by Ms. Clark and her students, some of which were in contrast to traditional Yup'ik norms. As in the case of the Mazahua principal, the "strongly contrastive interactional behavior presented no obstacle to the development of trusting relations with the students" (Paradise, 1994, p. 66). Both Ms. Clark and the principal invited their students' trust by openly communicating a respect and acceptance of them in ways that were not necessarily dependent on culturally accepted ways of interaction.

Discussion

Ms. Clark's case first came to our attention because of her students' high gain scores on pre- and post-tests for the *Building a Fish Rack* module. As we looked deeper into the data for the underlying additional factors contributing to this high academic achievement, we discovered that Ms. Clark's case was an exemplar of not only academic gains, but also of good pedagogical fit between Ms. Clark and MCC. The curriculum provided Ms. Clark with an instructional approach compatible with her student-centered, activity- and inquiry-based teaching philosophy as well as giving her support in math content. The case also illustrated how the notions of pedagogy, math content, and culture came together in a "third space," which was co-created by Ms. Clark and the students.

At the outset, we discovered that Ms. Clark rejected the generalized notions about Alaska Native students and set out to uncover their funds of knowledge by listening to her students as they taught her about the outdoors. The time she spent listening to and observing her students as experts allowed her to establish a connection that was key to her goal of developing a learning community in her classroom. Ms. Clark's pedagogical orientation was to develop a participatory approach to teaching that capitalizes on children's knowledge and experiences. As Connell (1994) writes, "To teach well in disadvantaged schools requires both a shift in pedagogy and the way we think about content. This shift should be toward a more negotiated curriculum and more participatory practice" (p. 137).

The mathematics curriculum provided a key support for the teacher to transform her knowledge of the students' funds of knowledge into classroom activity. From our point of view, this curriculum is a solid example of linking everyday mathematics and school mathematics (see Civil, 2002, for a discussion of these different forms of mathematics). The curriculum also reflects how bringing in the community's ethnomathematics may help bridge to the more "academic"

content. Thus, it responds affirmatively to the question posed by Hoyles (1991), *"is it possible to capture the power and motivation of informal non-school learning environments for use as a basis for school mathematics?"* (italics in original; p. 149). Further, this curriculum, and most importantly the pedagogical approach that goes along with it, could address the issue of the different values assigned to the different forms of mathematics (Abreu, 1995; Nunes, 1999). Nunes (1999) argues for the need to learn about the varied mathematical practices that are used by different groups: "these different practices can offer a vision of a diversity of reasoning schemas, many of which are currently not used to the learners' advantage in the classroom" (p. 50). In the module discussed in this paper, the cultural practices are not only valued but can be used to explore different forms of mathematics, including "academic" mathematics.

The module's use of cultural contexts also provided a good fit with Ms. Clark's beliefs about teaching. In the episodes discussed above, the teacher used the cultural connection as a way of giving her students a greater sense of ownership in their learning. Further, the combination of the cultural component and the math content in MCC helped to create a third space in which a dialogue between academic content knowledge and indigenous knowledge could take place in a learning community that brought together the students' knowledge and cultural backgrounds and that of a teacher/outsider, educated in progressive schools based in an inquiry approach to instruction and assessment. Finally, a "third space" was co-created by Ms. Clark and her students as they co-constructed new cultural norms in the classroom, which produced forms of communicating and interacting that at first seemed in conflict with traditional Yup'ik cultural norms. However, within this third space, the students and Ms. Clark could co-construct new norms of communicating that produced a cultural consonance, which promoted meaning making for all participants in the learning environment.

In closing, it appears that the coordination of the module's design philosophy and the teacher's instructional philosophy allowed an environment where the students were able to demonstrate significant progress. If this is the case, it gives strength to the theoretical framework of the module as designed. We observe that in this situation, cultural connections and development of a classroom community were given as much importance as the mathematics content. At the same time, the students were engaged in the lesson. This case also indicates that current ideas about mathematics education reform can complement the use of traditional cultural practices in school in more than just theoretical ways. We have seen that when combined with the cultural context, an inquiry model of teaching gave the students the opportunity to become active participants in a comfortable and relevant context. This suggests that it would be fruitful to conduct future research on the interaction between a pedagogical approach centered on inquiry and an approach designed specifically to develop classroom community. We also feel that this research provides further evidence of how informal learning environments can be used as a bridge toward more traditionally oriented mathematical concepts.

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Endnotes

[1]A *tool* can be language, a counting system, music or visual art. Tools, such as language, construct signs, such as words.

REFERENCES

Adams, B., & Lipka, J. (2003). *Building a fish rack: Investigations into proofs, properties, perimeter, and area*. Calgary: Detselig Enterprises Ltd.

Carspecken, P. F. (1996). *Critical ethnography in educational research: A theoretical and practical guide*. NY: Routledge.

Civil, M. (2002). Everyday mathematics, mathematicians' mathematics, and school mathematics: Can we bring them together? In M. Brenner and J. Moschkovich (Eds.), Everyday and academic mathematics in the classroom. *Journal of Research in Mathematics Education Monograph #11,* 40-62. Reston, VA: NCTM.

Clements, D., & Battista, M. (1992). Geometry and spatial reasoning. In D. Grouws, (Ed.), *Handbook of research on mathematics teaching and learning,* 420–464. NewYork: Macmillan.

Connell, R. W. (1994). Poverty and education. *Harvard Educational Review, 64*(2), 125-149.

de Abreu, G.(1995). Understanding how children experience the relationship between home and school mathematics. *Mind, Culture, and Activity, 2*(2), 119-142.

Fairclough, N. (2003). *Analysing discourse: Textual analysis for social research*. London: Routledge.

Gutierrez, K. D., Rymes, B., & Larson, J. (1995). Script, counterscript, and underlife in the classroom: James Brown versus Brown V. Board of Education. *Harvard Educational Review 65*(3), 445-471.

Gutierrez, K. D., Baquedano-Lopez, P., Alvarez, H., & Chiu, M. M. (1999). Building a culture of collaboration through hybrid language practices. *Theory into Practice 38*(2), 87-94.

Habermas, J. (1987). *The theory of communicative action: Lifeworld and the system: A critique of functionalist reason, 2,* T. McCarty, Trans. Boston: Beacon.

Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*(5), 524-549.

Hoyles, C. (1991). Developing mathematical knowledge through microworlds. In A. J. Bishop, S. Mellin-Olsen, & J. van Dormolen (Eds.), *Mathematical knowledge: Its growth through teaching,* 147-172. Boston, MA: Kluwer.

Kahn, L. H., & Civil, M. (2001). Unearthing the mathematics of a classroom garden. In E. McIntyre, A. Rosebery, and N. González (Eds.), *Classroom diversity: Connecting curriculum to students' lives,* 37-50. Portsmouth, NH: Heinemann.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lipka, J. (1991). Toward a culturally based pedagogy: A case study of one Yup'ik Eskimo teacher. *Anthropology and Education Quarterly, 22*(3), 203-223.

Lipka, J., Hogan, M., Webster, J. Parker, Yanez, E., Adams, B., Clark, S., & Lacy, D. (2005). Math in a cultural context: Two case studies of a successful culturally based math project. *Anthropology and Education Quarterly, 36*(4), 367-385.

Moje, E. B., Ciechanowski, K. M., Kramer, K., Ellis, L., Carrillo, R., & Collazo, T. (2004). Working toward third space in content area literacy: An examination of everyday funds of knowledge and discourse. *Reading Research Quarterly 39*(1), 38–70.

Moll, L. C., Vélez-Ibáñez, C., Greenberg, J., Whitmore, K., Saavedra, E., Dworin, J., & Andrade, R. (1990). *Community knowledge and classroom practice: Combining resources for literacy instruction* (OBEMLA Contract No. 300-87-0131). Tucson, AZ: University of Arizona, College of Education and Bureau of Applied Research in Anthropology.

Moll, L. C. (1992). Bilingual classrooms and community analysis: Some recent trends. *Educational Researcher, 21*(2), 20-24.

Moll, L., Amanti, C., Neff, D., & González, N. (1992). Funds of knowledge for teaching: A qualitative approach to developing strategic connections between homes and classrooms. *Theory into Practice, 31*(2), 132-141.

Nunes, T. (1999). Mathematics learning as the socialization of the mind. *Mind, Culture, and Activity: An International Journal, 6*(1), 33-52.

Paradise, R. (1994). Spontaneous cultural compatibility: Mazahua students and their teachers constructing trusting relations. *Peabody Journal of Education, 69*(2), 60-70.

Rogoff, B. (1994). Developing understanding of the idea of communities of learners. *Mind, Culture, and Activity, 1*(4), 209-229.

Rosenblatt, L. M. (1978). *The reader the text the poem: The transactional theory of the literary work.* Carbondale, IL: Southern Illinois University Press.

Silva, R., & Webster, J. P. (2004). *From rhetoric to reality: Do teachers have a role in translating national policy directives into action?* Paper presented at The Oxford Ethnography and Education Conference, Oxford University, Oxford, UK.

Smagorinsky, P. (1995). The social construction of data: Methodological problems of investigating learning the zone of proximal development. *Review of Educational Research, 65*(3), 191-212.

Stein, M. K., & Smith, M. S. (1998). Mathematical tasks as a framework for reflection: From research to practice. *Mathematics Teaching in the Middle School, 3*(4), 268-275.

Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2000). *Implementing standards-based mathematics instruction: A casebook for professional development*. NY: Teachers College Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E Souberman, Eds.). Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1934/1987). Thinking and speech. In L. S. Vygotsky, *Collected works, 1,* 39-285. (R. Rieber & A. Carton, Eds.; N. Minick, Trans.). NY: Plenum. (Original work published 1934).

Webster, J. P. & Lipka, J. (2004). Why can't we just do math? Exploring the tensions within the in-between space of a culturally responsive curriculum. In B. Jefffries, G. Troman, & G. Walford (Eds.), *Policy issues in educational research: 2003 conference edited collection*. London: JAI Press.

Webster, J. P., & Silva, R. (2004). *Interpreting networks of meaning from a critical perspective: Who benefits from the official definitions of highly qualified teachers?* Paper presented at the National Reading Conference, San Antonio, TX.