HOW THE KNOWLEDGE OF COGNITIVELY GUIDED MATHEMATICS INSTRUCTION HELPED ONE ONEIDA INDIAN KINDERGARTEN TEACHER TEACH IN A CULTURALLY RESPONSIVE WAY

> Surprisingly little attention has been given to the teaching methods used in teaching ethnic minority students in this country, particularly when the notion of culturally relevant curriculum materials has been around as long as it has. It is as if we have been able to recognize that there are cultural differences in what people learn, but not in how they learn. (Phillips, 1982)

The preceding quote serves as a lens through which this paper is focused. Here, Phillips succinctly identifies a critical issue - the importance of culturally compatible teaching methods. It was this issue that grounded a two year investigation (Hankes, 1998) into the pedagogical compatibility between an Oneida Indian way of teaching and Cognitively Guided Instruction, a constructivist-based approach for teaching primary level mathematics (Carpenter, et al., 1998). Besides affirming compatibility, the study also documented how one kindergarten teacher, an Oneida Indian, shifted from culturally insensitive mathematics instruction to culturally responsive instruction. This article reports how Cognitively Guided Instruction enabled this shift.

Background Information

My investigation into culturally responsive mathematics instruction of Native American children was motivated by the fact that American Indians/Alaska natives have the smallest percentage of secondary and post-secondary students performing at the advanced level in mathematics of all ethnic groups (Hillibrandt, Romano, Stang & Charleston, 1992; Nelson-Barber & Estrin, 1995;Trumbull, Nelson-Barber, & Mitchell, 1998). The primary purpose of the study was to determine whether the teaching methods practiced by teachers implementing Cognitively Guided Instruction were compatible with teaching methods characteristic of generalized Native American pedagogy (Hankes, 1998) and specifically with traditional Oneida Indian teaching methods. The study affirmed this compatibility and identified five specific pedagogical principles shared between these approaches. **The following table** outlines these principles.

Table 1
Correspondence between Native American Pedagogy and Cognitively Guided Instruction

Instruction Focus Area	Dominant Culture Pedagogy	Cognitively Guided Instruction	Native American Pedagogy
Role of the Teacher	Teachers generally behave in a didactic manner, disseminating information to students.	Teachers generally behave in an interactive manner, mediating the environment for the student.	The facilitating teacher role promotes cooperative and autonomous learning. Individual speakers do not control conversational topics.
Student to Student	Students primarily	Students primarily	Care taking patterns of

Interaction	work alone.	work in-groups.	extended families and bonded community interactions are replicated in-group learning experiences.
Curriculum	Curriculum activities rely heavily on textbooks and workbooks.	Curricular activities rely heavily on primary sources of data and manipulative materials.	Lessons relate to real problems that will likely confront the student.
Time	The day is partitioned into blocks of time and content coverage. "Time on task" is considered important.	Class time is spent solving complex problems. Students are encouraged to reflect on and discuss their own and other's thinking.	Instruction/learning is time-generous rather than time-driven. When an activity should begin is determined by when the activity that precedes it is completed.
Concept Formation	Concepts are presented part to whole with emphasis on basic skills.	Concepts are presented whole to part with emphasis on big ideas.	All knowledge is relational, presented whole-to-part not part-to-whole. Just as the circle produces harmony, holistic thinking promotes sense making.
View of Learner	Students are viewed as blank slates onto which the teacher etches information.	Students are viewed as thinkers with emerging theories about the world. Students are believed to possess prior knowledge.	Each student possesses Creator-given strengths and is born a thinker with a life mission.
Assessment	Student assessment is viewed as separate from teaching and occurs almost entirely through testing. Testing often stratifies students and promotes competition.	Assessment is interwoven with teaching and occurs through questioning and observation of student work. Each student is instructed at her/his appropriate learning level. There is little, if any use for competition.	Age and ability determine task appropriateness. Learning mastery is demonstrated through performance. Creator ordained mission determines one's role in life, and no one mission is better than another is. Competition, situating one as better than another is discouraged.

The study involved one kindergarten teacher, an enrolled member of the Oneida Reservation, Oneida, Wisconsin, and her class of seventeen Oneida children. Over a two

year period, this teacher participated in two thirty hour Cognitively Guided Instruction (CGI) workshops, observed in CGI classrooms, and frequently conferenced with the researcher about CGI principles while implementing the approach with her students.

Walking the Talk: Teaching in a Culturally Responsive Way

One would assume the participating teacher would have been an informant capable of identifying commonalties and differences between a culturally responsive Oneida way of teaching and Cognitively Guided Instruction. But this assumption was found to be invalid; the teacher was initially unable to articulate what an Oneida way of teaching might be. She possessed what Watson (1974) alluded to as "assumptions of everyday life . . ., which are so much a part of the culture that they are not even consciously held." The teacher had never been asked to reflect on culturally responsive methods of instruction, and when asked to, her response was, "I really don't know."

The teacher's initial inability to reflect on a culturally sensitive way of teaching shifted the study from simply identifying shared methods, such as indirect instruction and cooperative learning, to investigating the deeply held cultural beliefs that informed her instructional practices. This investigation included culture-probing interviews with the teacher as well as with four elder Oneida educators. Interview analysis identified an underlying and unifying belief - the belief in spirituality and the divine act of creation. Three related values were also identified: valuing harmony, valuing generosity, and valuing cooperation. Interview analysis revealed that each informant linked instructional practices such as cooperative grouping, indirect instruction, even trusting the child's ability to independently problem solve back to the "Creator's intended purpose for placing life on the planet." The following comment of one elder educator expresses this belief.

> The universal truth being that life-producing, life-making is a give-away and a sharing, and we are exemplifying the Creator who did that first when creating and who gave the original instructions that this must continue . . .. The importance of generosity and the importance of cooperation as a human phenomenon allow humans to replicate what is already surrounding us in nature. These behaviors help us fit into the interconnected schema . . .. If we don't, things will go out of balance. There will not be harmony. (CC, int.3 of 3, 5-18-94, lines 107-150)

Interestingly, not until informal discussions with the kindergarten teacher reached this level of culture analysis was she able to reflect on her instructional practices and identify how her values and beliefs informed her teaching. Culture probing interviews also enabled the teacher to reflect on the teaching practices of Cognitively Guided Instruction as she understood them and discuss how they corresponded with culturally sensitive teaching. In the following comments the teacher speaks of this correspondence:

> [With CGI] kids are solving problems that they can succeed with. I'm not asking them to do something that they can't do. Some of them go on to different problems that are harder, but if someone isn't ready to do that, then they work with a problem that is right for them. I think that's being culturally sensitive. Relating it back to culture, children were given responsibilities and jobs that they were able to succeed at or were good at or they had the gifts to do. We believe that the Creator has given everyone some gift and everyone has different ways to do things. That way of teaching is

culture, but it's also CGI because kids can solve problems in ways that make sense to them. There's not just one way. (KT, int. 5 of 5, 5-17-94, lines 475-488)

[Sharing is cultural.] It can be traced back to creation, and in CGI children share their strategies, their thinking, but what is also shared is their enthusiasm, the eagerness to share problems, and the satisfaction of success. You know, when a child says, "I got it!" When a child is really excited about solving a problem, that excitement is shared. (KT, int. 5 of 5, 5-17-94,lines 706-813)

[CGI is culturally sensitive] because it's their own thinking. I don't want to say it's not white, that it's not a white man's way of thinking. You give the children the problem. It doesn't matter what tribe or color, and let the children work it out for themselves. This isn't anybody's way. This is the child's way, and I think it's the same with all children, that's the way God made them. With CGI, Native American children have the same chance as anybody. Society has suppressed Indian people. I remember when I was going to school, I didn't think I was smart because I couldn't solve the problems the way I was supposed to, the way the book said. But with CGI, children can make sense any way that their minds work, and they are given enough time to do it. That gives them success, and they feel good about math. So, for Indian children, I think CGI fits very well. (KT, int. 5 of 5, 5-17-94, lines 719-736)

I think it fits culturally just for the fact that with CGI it's more age appropriate. In the culture, they used to teach when children were ready, and I think that parallels . . . . The situation where the teacher is guiding them, not telling them, where the teacher is letting them find their own answers, letting them draw conclusions for themselves. Also, I think there's more cooperation, more of a group effort. Everybody is encouraged to work together. It's not like they are trying to decide who is the best or who is not the best. It's where they are that's important and what they can contribute to the group. That's culture, and I see that in CGI. (KT, int. 4 of 5, 4-14-94, lines 7-12)

Before shifting from this discussion of cultural correspondence, having confirmed similarities, it is both interesting as well as important to reflect on the philosophical foundations of the Oneida way of teaching and CGI and consider how these approaches differ. The Oneida way was/is grounded on deeply held spiritual values of Indian people; whereas, the principles of Cognitively Guided Instruction were derived from the integration of research based knowledge constructed by educators within academia. One community believes the learner to be capable of independent problem solving because that is what humans are created to do; the other believes that the learner is capable of independent problem solving because that is how human beings construct understanding.

How CGI Helped One Teacher Shift from Culturally Non-Responsive to

Culturally Responsive Instruction

The following comments reveal a problematic situation - though the teacher possessed knowledge about Oneida culture and evaluated her instruction of most other content areas as culturally sensitive, she admitted that her mathematics instruction mirrored that of the dominant culture. She relied on a text and worksheets.

> [Before] I just followed the workbook manual and had the kids do what they were supposed to do in the workbook to cover that year, and I always wondered why kids were struggling. This (CGI) just seems more natural. I make lessons from what intrigues them. . . . I've incorporated my own ideas, and I'm not relying on a workbook. (KT, int. 1 of 5, 9-18-92, lines 261-267, 519-521)

> It seems that I'm always doing math [laugh]. Before, I always had a set time. I took about 35 minutes to present, and then we did our little worksheets, but now we just to a lot more. . . . It's more intertwined in everything that we do. (KT, int. 1 of 5 4-14-94, lines 289-302)

Additional comments reveal how the teacher felt about mathematics before CGI as well as how and why these feelings changed following CGI.

> Personally, I never really liked math, but I'm learning to be more appreciative of it since CGI. Now it's a lot more fun, and I'm finding more ways to incorporate it into my classroom, and as I see the kids how they're having fun, it makes me want to challenge them more. (KT, int. 1 of 5, 9-18-94, lines 48-54)

> [Why I like CGI is] everybody can feel successful. I can remember not being successful in math. I still have a math phobia. So it's real uplifting and real nice to see these little kids enjoying math. (KT, int. 2 of 5, 10-14-93, lines30-36)

> I guess the biggest difference is now I have a better understanding of math and how kids develop, go through stages to get where they understand. I know when I used to teach math the kids couldn't get it. Now I realize that there are different stages, different developmental stages in problem solving, in how they understand. Now I know it's not the fault of the child. It's just that they are not at that level. (KT, int. 4 of 5, 4-14-94, lines 31-38)

> I understand the problem types, and I'm beginning to understand the way kids go about solving them, their strategies. Before, I didn't know how to do that. I really didn't understand the developmental levels of children's thinking as far as math is concerned. I didn't even understand the math. (KT, int. 4 of 5, 4-14-94, lines)

> (CGI) gives them the freedom to think, to problem solve for themselves . . . . We're on equal ground now because they know that I don't have all the right answers all the time, and I have to figure it out myself. (KT, int. 1 of

5, 9-18-92, lines 412-421)

> Now I'm doing a lot more visual things like graphing, voting on things, then graphing and asking questions about the graph, having them compare, and now I use literature, integrate math into stories that I read aloud and then ask math questions from. I integrate the culture more. I ask math questions from culture stories. (KT, int 4 of 5, 4-14-94, lines 52-56)

An interesting contradiction emerges at this point. Prior to CGI, though the teacher was aware of the fact that her students were confused and unsuccessful completing workbook pages, why did she continue with the workbook approach, especially when she was able to apply what has been identified as an Oneida way of teaching with other content areas? Two statements sequestered within the reported comments help answer these questions: "I really didn't understand children's developmental levels of thinking as far as math is concerned. I didn't even understand the math." Though the teacher possessed Oneida culture knowledge, her lack of mathematical knowledge and knowledge of children's thinking about mathematics forced her to rely on textbook for instruction. The way she taught replicated the way she had been taught, and, having never developed mathematical understanding, she lacked the necessary knowledge to teach mathematics differently. Though she was an Oneida tribal member and recognized by her community as knowledgeable about Oneida culture, she was unable to teach mathematics in a culturally sensitive way.

Findings of this study suggest that for instruction to be culturally responsive the teacher must possess both culture and content knowledge. Deep culture knowledge is that latent socially constructed and community-based knowledge that is integral to each person's life but difficult to articulate. It was this knowledge that the teacher had to become conscious of through thoughtful reflection before she was able to consider the cultural compatibility of Cognitively Guided Instruction. Additionally, the teacher had to become knowledgeable about Cognitively Guided Instruction, specifically the mathematics content and children's thinking about that content, before she was able to rely on this knowledge to inform her instruction and before she could recognize how processing this knowledge allowed her to teach in a culturally responsive way. The following comments reveal how this integrated knowledge influenced the teacher's instruction and mathematical confidence:

> My aide is, I think she is in shock because she just doesn't know where I'm coming from with all this stuff. Math ideas are just in my head now. They just come out when I'm thinking about CGI, thinking about ways of doing it, and math is fun for them now. . . . I never grew up with a real confidence in math, so I guess the big thing that changed for me is that now I feel more confident. (KT, int. 1 of 5, 9-14-92, lines 475-485)

The preceding comments, though thought provoking, are not convincing in themselves when reflecting on the purpose of the study, determining whether culturally responsive instruction enhances the learning of Native American students. The merit of the teacher's change from culturally non-responsive to culturally responsive had to be evaluated by assessing her students' learning. The next section reports the assessment findings.

The Problem Solving Success of Oneida Kindergartners Taught with CGI

The assessment methodology followed in this investigation replicated a Cognitively Guided Instruction kindergarten study completed in 1990 (Carpenter et al., 1993). Data analysis of the findings revealed that the seventeen Oneida kindergartners demonstrated similar performance when compared to the kindergartners in the 1990 study. On a nine item test (Table 2) the Oneida student performed as well as the 1990 kindergartners on one item, not as well on one item, and slightly better on seven items (Table 3). Additionally, of the 17 children tested in the Oneida study, eight used a valid strategy for all nine problems (47% of the total compared to 46% in the earlier study, and thirteen used a valid strategy and correctly calculated the answers to seven or more problems (76% of the total compared to 63% in the 1990 study). Findings document that the Oneida children demonstrated remarkable mathematical problem-solving ability, an ability that contradicts assumptions of low mathematical aptitude among Indian children.

Table 2
Interview Problems

Problem Type	Word Problem
Separate (result unknown)	Paco had 13 cookies. He ate 6 of them. How many cookies does Paco have left?
Join (change unknown)	Carla has 7 dollars. How many more dollars does she have to earn so that she will have 11 dollars to buy a puppy?
Multiplication	Robin has 3 packages of gum. There are 6 pieces of gum in each package. How many pieces of gum does Robin have altogether?
Compare (difference unknown)	James has 12 balloons. Amy has 7 balloons. How many more balloons does James have than Amy?
Measurement Division	Tad had 15 guppies that he put into jars. If he put 3 guppies in each jar. How many jars did Tad put guppies in?
Partitive Division	Mr. Gomez had 20 cupcakes. He put the division cupcakes into 4 boxes so that there were the same number of cupcakes in each box. How many cupcakes did Mr. Gomez put in each box?
Division (with remainder)	19 children are going to the circus. 5 remainder children can ride in each car. How many cars will be needed to get all 19 children to the circus?
Multi-step	Maggie had 3 packages of cupcakes. There were 4 cupcakes in each package. She ate 5 cupcakes. How many are left?
Non-routine	19 children are taking a minibus to the zoo. They will have to sit either2 or 3 to a seat. The bus has 7 seats. How many children will have to sit 3 to a seat, and how many will have to sit 2 to a seat?

Table 3
A Comparison of Percentiles of the Oneida study

Problem Type	Oneida	1990
Separate (result unknown)	100%	89%
Join (change unknown)	76%	80%
Compare (difference unknown)	76%	71%
Multiplication	94%	86%
Measurement Division	76%	73%
Partitive Division	76%	70%
Division (with remainder)	71%	64%
Multi-step	82%	67%

Non-routine	59%	59%

Conclusion

It is believed that the present study provides convincing evidence that one Oneida Indian teacher changed her instruction from culturally non-responsive to culturally responsive and that the teacher attributed this change to Cognitively Guided Instruction, to acquiring knowledge of mathematics and children's thinking about mathematics. The study also documented the problem solving success of seventeen Oneida kindergartners. Further research is needed to determine culturally sensitivity and effectiveness of Cognitively Guided Instruction with other Native American populations and primary grade levels.

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