Development, Validation, and Preliminary Use of the Culturally Congruent Instruction Survey

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Abstract

Scholars hypothesize that cultural incongruities between classroom instruction (in terms of pedagogy, content and environment) and students' home cultures hinder diverse students' learning. A small but growing number of research studies is providing evidence indicating that improving teachers' use of culturally congruent instruction (CCI) improves diverse students' achievement. Calls for more research on the efficacy of CCI in supporting diverse students' learning are increasing, but a lack of valid methods and instruments for assessing CCI creates challenges for conducting research in this area. This paper describes work on the development, validation and preliminary use of a teacher self report survey designed to assess the frequency of teachers' use of culturally congruent instructional practices in teaching science with K-8 American Indian students in Montana. The instrument is currently being employed in a quasi experimental study to assess impacts of a teacher professional development project on teachers' CCI. Changes found in teachers' CCI to date and results of initial analyses to characterize and begin to validate the instrument are described.

Introduction

Ethnic Diversity and Achievement Gaps in the United States

The ethnic diversity of the K-12 student population in schools in the United States is increasing, in step with the increasing diversity in the country's overall population. Recent figures indicate that 43% of K-12 U.S. students are members of ethnic minorities, a percentage that continues to rise each year. Conversely, the overwhelming majority of U.S. K-12 teachers are White people of European descent. By 2008 figures, 83.5% of teachers reported that they are White, non Hispanics, a number that has increased slightly in recent years (Institute of Education Sciences, 2008). Western culture, based on Eurocentric values, norms, and worldviews, continues to be the predominant cultural influence in much of U.S. society and many of its institutions, including education.

Although in some cases the disparities are slowly narrowing, a wide array of measures of academic achievement continue to indicate that ethnic minority students attending America's schools are significantly underachieving compared to their White peers. On the National Assessment of Educational Progress for mathematics taken by nine year old students in 2008, for

example, U.S. Latinos/as scored 16 points lower and African Americans scored 26 points lower than White students on a 500 point scale (Rampey, Dion & Donahue, 2009). This differential in test scores by ethnicity generally increases as students progress through elementary and secondary school.

Other measures of academic success affirm this pattern of underachievement by ethnic minority students. For example, White students drop out of precollege education at a rate of 6% of their total number, African Americans drop out at a rate of 11% and Latino/a students drop out at a rate of 22% (IES, 2008). Forty one percent of all dropouts are Latino/a, even though they only make up 17% of U.S school age youth. Likewise, 66% of all degrees awarded between 2005 and 2007 were earned by non Hispanic Whites, on par with their total population percentage. Meanwhile, 9% of degrees in that same time period were awarded to African Americans and 7% were awarded to Latinos/as, ethnic groups that made up 12% and 15% of the U.S. population respectively (Institute of Education Sciences, 2008).

Achievement Gaps for Montana's American Indian Students

In Montana, scores on measures of achievement are likewise out of balance for American Indian and White students, the state's two largest ethnic groups. On the 2007 NAEP fourth grade test of reading, for example, only 17% of Montana's American Indian students scored in the proficient or higher categories compared to 42% of White students. Similarly, on the 2007 NAEP eighth grade math test, only 15% of American Indian students scored in the proficient or higher categories compared to 41% of White students (The Education Trust, 2009). Although Montana students overall scored second highest among the fifty states on the 2005 eighth grade NAEP science test, only 14% of Montana's American Indian students scored in the proficient or higher category on the test, compared to 45% of White students. Students overall score higher on Montana's relatively new criterion referenced tests (CRT), but the gaps in scores between American Indian and White students persist. Only 63% of the state's American Indian students scored in the proficient or higher categories on the 2010 eighth grade reading state CRT, compared to 87% of Montana's White students. Similar disparities occurred in the scores on the 2010 eighth grade math state CRT, with only 40% of Montana's American Indian students scoring in the proficient or higher categories, compared to 71% of White students. In Science the same pattern emerged, with 29% of Montana's eighth grade American Indian students and 62% of White students scoring proficient or above (Montana Office of Public Instruction, 2010). On time high school graduation rates were 58% for Montana's American Indian students in 2006, compared to a rate of 84% for White students in the state for the same year. In 2006, 11% of American Indian and 28% of White adults in Montana over the age of twenty five had attained a four year college degree (The Education Trust, 2009).

Theoretical Framework

Culturally Congruent Instruction and Academic Achievement

Research in education has uncovered correlations between achievement gaps and a wide number of factors including school based factors such as teacher preparation and experience (Darling - Hammond, 2000), teacher practice (Wenglinsky, 2000), rigor of the curriculum, and school safety; factors external to school and often associated with socioeconomic status such as student nutrition, enrichment activities (like reading to children) and student mobility; and those factors that connect school and home, like parent participation in their student's education (Barton and Coley, 2009). Adverse conditions that have been correlated with lower student achievement are

disproportionately more commonly experienced by ethnically diverse students (Almy & Theokas, 2010; Annie E. Casey Foundation, 2006; Applied Research Center, 2008; Lankford et. al. 2002; Schmidt, Cogan & McKnight, 2010).

Another potential set of factors hypothesized as contributing to the underachievement of ethnically diverse students is rooted in the cultural incongruities that commonly exist between minority students' home cultures and that of their teachers and schools (e.g., Lee & Buxton, 2010; Barnhardt and Kawagley, 2005; Lipka & Adams, 2004; Gay, 2000; Boykin & Bailey, 2000; Skinner, 1999). Cultural incongruities encompass a suite of factors such as a lack of curriculum content relevant to ethnically diverse students' lives; incompatibility between the behavioral norms of schools, classrooms and students' home cultures; differences between the language of instruction and students' home language; and a disconnect between the pedagogy used in typical American classrooms and the traditional teaching methods familiar to ethnically diverse students (Lee, Luykx, Buxton and Shaver, 2007; Barndhardt, 2005; Hilberg and Tharp, 2002; Yazzie, 1999). These same scholars have hypothesized that reconciling the cultural incompatibilities between students' home cultures and schools through the use of more culturally congruent instruction (CCI) will improve the academic achievement of ethnically diverse students.

Culture and Culturally Congruent Instruction

Culture is a complex construct that is not easily defined. Carter (2000) defines culture as "learned patterns of thought and behavior that are passed from one generation to another and are experienced as distinct to a particular group (p. 865). Demmert and Towner (2003) state that culture can be "viewed as the beliefs, behaviors, and characteristics of a particular social, ethnic, or racial group, and includes application of both traditional and contemporary mores and understandings as influenced by individuals and groups." (p. 5). According to Parsons (2003), culture is the world view, orientations, and values that mediate the behavior of a group of people. Lee & Buxton (2010) write that culture "generally refers to the values and worldviews shared by the members of a social group" and notably points out that culture "serves as a framework for how we interpret and interact with other individuals and with the broader world around us." (p. 12). Even in the absence of an exact definition, it is generally agreed that culture is a dynamic construct that is continuously being shaped and reshaped by a people's history and ongoing interactions with other people and their environment.

The term "culturally congruent" first appeared in the education literature in the 1980's (for example, Mohatt and Erickson, 1981; Au and Jordan, 1981). Pewewardy & Hammer (2003) describe culturally congruent instruction as that which "builds a bridge" between the student's home culture and that of the school to support students' learning and achievement. Lee and Buxton (2010) describe culturally congruent instruction as occurring when "Teachers interact and communicate with students in ways that are familiar to students in their homes and communities, as well as use cultural artifacts, examples, analogies, and community resources." (p. 65). Related terms that are often used interchangeably with CCI in the education literature include culturally responsive education (CRE), culturally based education (CBE), and culturally relevant teaching (CRT). While each scholar tends to favor one term over another and some have even compared and discussed the nuances of each term, there does not to be general agreement on the precise definition of each and overlap in their use still occurs in the literature.

Just as there are distinct differences and yet considerable overlap evident in how scholars refer to and define CCI, this same situation exists when scholars operationalize CCI by

identifying its essential behaviors. Table 1 lists behaviors characteristic of culturally competent instruction/instructors as identified in the education literature by four different sets of authors. Examination of these four syntheses reveals that each set of authors, whether derived from his or her own work or from that of others, lists a set of traits that are uniquely worded and nuanced but that also overlap substantially in their meaning with those lists from other authors in the table. For example, the use of culturally responsive pedagogy and culturally relevant content are identified as essential elements of CCI by all four sets of authors. Two of the authors (Phuntsog and Siwatu) explicitly identify the establishment of culturally responsive learning environments as important to CCI. Similarly, Demmert and Towner's (2003) compilation of traits implicitly includes classroom environment through their identification of the observance of cultural mores of behavior and traditional interactions between adults and Indigenous students as essential to CCI. Further, all four either implicitly or explicitly emphasize the acknowledgement and validation of cultural diversity as essential to CCI.

Author(s)/Year	Elements of Culturally Competent Instruction Identified
Phuntsog, 1999	Five traits of culturally competent teachers, synthesized from a review of the literature: 1. Stresses respect for diversity to engage the motivation of all learners 2. Creates a safe, inclusive, and respectful learning environment 3. Integrates responsive teaching practices into all disciplines 4. Transforms curriculum to promote social justice and equity in society 5. Is culturally literate
Gay, 2000	Five traits of culturally responsive teaching, identified by the author: 1. Acknowledges the legitimacy of the cultural heritages of different ethnic groups, both as legacies that affect students' dispositions, attitudes, and approaches to learning and as worthy content to be taught in the formal curriculum 2. Builds bridges of meaningfulness between home and school experiences as well as between academic abstractions and lived sociocultural realities 3. Uses a wide variety of instructional strategies that are connected to different learning styles 4. Teaches students to know and praise their own and each others' cultural heritages 5. Incorporates multicultural information, resources, and materials in all the subjects and skills routinely taught in schools (p. 29)
Demmert and Towner, 2003	Six elements of culturally based education for Indigenous students, synthesized from a review of the literature: 1. Use of Native language 2. Pedagogy that uses traditional cultural characteristics and adult child interactions 3. Pedagogy that emphasizes both traditional and contemporary ways of knowing 4. Curriculum based on traditional culture and contemporary contexts and that recognizes the significance of spirituality 5. Significant community involvement in the planning and operation of education

	6. Use of community mores in classroom interactions
Siwatu, 2005	Four traits of culturally based education, identified by the author: 1. Uses students' cultural knowledge, experiences, prior knowledge and learning preferences to facilitate the teaching and learning process 2. Incorporates students' cultural orientations to design culturally competent classroom environments 3. Provides students with multiple opportunities to demonstrate what they have learned using a variety of assessment techniques 4. Provides students with the knowledge and skills needed to function in mainstream culture while helping them maintain their cultural identity

Table 1 – Characteristic behaviors associated with culturally congruent instruction as identified by four sets of authors in the research literature

Delineating the common elements of CCI as in Table 1 assists in understanding the commonalities and distinctions that exist between CCI and typical mainstream teaching. The elements of CCI, unless identified for a specific cultural group, are commonly stated in broad and general terms so that they are relevant to a wide range of culturally diverse groups. A generalized definition of CCI lacks precision when describing the operationalization of CCI with a specific ethnic group, however, because the uniqueness of each cultural group of people means also that the classroom manifestations of CCI must be customized in order to assure congruence with their culture. The operationalization of CCI, for example, in terms of what teachers and students are doing and how they interact, the curriculum content and types of curriculum resources utilized, and the layout of the classroom, will look different for each cultural context. As an illustration, instruction cited in the literature as compatible with the home cultures of many African American students incorporates elements of movement, verve and communality (Boykin, Coleman, Lilja & Tyler, 2004; Hurley, Boykin, & Allen, 2005; Boykin & Bailey, 2000). In contrast, instruction that scholars identify as compatible with the home cultures of many American Indian students incorporates elements of student reflection and private practice, observational learning, multiple mentors from the extended family and community, spirituality, holistic learning and communalism (Cajete, 2005, 1999; Hilberg & Tharp 2002; Deloria & Wildcat, 2001). Also in contrast, instructional practices that scholars describe as compatible with the home cultures of White European American students incorporates individualism, competition, linear logic and risk taking (Gay, 2000; Cajete, 1999; Deloria and Wildcat, 2001). Because Demmert and Towner's 2003 review of literature focuses specifically on Indigenous education they were able to focus the elements of CCI that they listed to be somewhat more specific, as can be seen in Table 1.

On the other side of this coin it is important to note that in discussing CCI for a given prioritized group of people, the elements of CCI are commonly generalized for the specific cultural group as a whole, with the recognition that a wide range of variation can and commonly does occur across subgroups and individuals within a cultural group. The study described in this paper, for example, involves five distinct American Indian cultures, all of which are Indigenous cultures of North America. Acknowledging the uniqueness of every tribal culture, the work described herein is constrained to and specifically targets the commonalities in CCI identified for these five cultures. The specific elements of CCI addressed by the instrument that was developed in this study were first defined broadly through a literature review of Indigenous education. In acknowledgement of the specificity of each American Indian tribal culture, the elements were

then reviewed and refined through participatory processes with the specific tribal peoples for whom the survey under study was developed.

While it is recognized that there are many definitions for CCI (and CBE, CRT, and CRE), in this study CCI is thought of as instruction that is compatible with and builds upon students' cultures such that it validates students' cultural identities, empowers students, capitalizes on their traditional ways of knowing and social norms, builds on their prior knowledge, and supports their learning. For the purposes of this study, CCI is furthered delineated as including three interacting components – content, pedagogy and learning environment. By content, it is meant the culturally congruent topics that are addressed in the curriculum, which in this context includes tribal oral history, Indigenous science knowledge, contemporary and historical issues related to science (both tribal and in the larger society of which students are members), as well as Eurocentric science knowledge. By pedagogy, it is meant the specific types of culturally congruent instructional strategies used by teachers and students in teaching and learning, including assessment. By learning environment, it is meant those things that contribute to a culturally congruent classroom atmosphere including the resources available to students and teachers (e.g., visuals and books), the physical setup of the classroom, as well as the rules, norms and power dynamics that constitute the classroom context and climate.

Research on the Efficacy of CCI in Supporting Math and Science Achievement

For decades, tribal entities, educational scholars specializing in diversity and equity, federal government agencies, and more recently, national education organizations, have advocated the use of CCI to improve educational outcomes for underperforming underrepresented groups of students (For example, Beaulieu, 2006; Demmert, Grissmer & Towner, 2006; Klump and McNeir, 2005). As is the case for most underrepresented groups, strong empirical evidence supporting the efficacy of CCI for improving Native American students' achievement, particularly in mathematics and science education, is limited. Demmert and Towner's 2003 literature review of 10,000 articles on CCI for American Indian and Alaska Native students (or as they call it culturally based education or CBE) found few studies that used rigorous methodology and even fewer that provided evidence of the efficacy of CCI in improving student achievement (Demmert & Towner, 2003).

A small but growing body of studies is emerging in the research literature that provides evidence supporting the importance of culturally congruent instruction. A subset of these studies examined the efficacy of CCI in raising diverse students' science and mathematics achievement, disciplines in which they have historically experienced significant achievement gaps compared to their White peers. Significant increases in achievement have been found as a result of using culturally congruent instruction in mathematics and science with African American and American Indian students (see, for example, Lipka, Parker and Yanez, 2005; Gilbert, 2005; Hurley, Boykin, & Allen , 2005; Boykin, Coleman, Lilja & Tyler, 2004; Hilberg, Tharp, & Degeest, 2000; Matthews and Smith, 1994). This section of the paper describes studies that utilize a research design with at least moderately high rigor and that provide evidence regarding the efficacy of CCI in influencing Indigenous students' math and science achievement.

Between Spring 2001 and Spring 2005, Lipka, Parker and Yanez conducted fourteen quasi experimental trials of culturally congruent mathematics instruction using the research group's original curriculum known as Math in a Cultural Context (MCC). Designed in collaboration with Yupik elders and mathematics reform oriented K-20 educators, MCC employs culturally congruent content and pedagogy in a guided problem solving curriculum designed to support

students' semi autonomy in regulating their own learning. Treatment students were taught using the MCC while control students were taught the same concepts using a more traditional textbook based approach. Over 3000 students in grades 2 through 6, both Yupik and non Yupik, comprised the total sample for the fourteen trials. The study collected pre and post instruction content test scores from treatment and control groups. Thirteen of the fourteen trials conducted found statistically significant greater increases in the treatment versus control group scores from the pre to post test, with effect sizes varying from moderate to strong (Lipka, Parker, & Yanez, 2005). The researchers concluded that utilizing the culturally competent MCC curriculum was effective in improving the achievement of elementary school students in mathematics.

Results of a more recent study involving the MCC curriculum conducted by Sternberg, Lipka, Newman, Wildfeuer and Gigorenko (2006) also suggest that CCI improves Indigenous students' mathematics achievement. This study involved 156 Yupik and non Yupik 6th grade students in seven communities and three districts in rural and urban Alaska settings. During the study period, treatment and control group students were taught the same mathematics concepts for the same length of time and at the same time. Treatment students were taught using the MCC curriculum and control students were taught using a more traditional, textbook-based approach. Post test scores for the treatment group students showed statistically significant greater gains compared to control group students, providing additional evidence for the efficacy of CCI in improving students' mathematics achievement.

Gilbert (2005) reported a quasi experimental study on science achievement involving ninety five fifth grade Navajo students from seven classrooms in five schools on the Navajo Reservation. Treatment and control students were assigned using a convenience sampling technique. Both treatment and control groups were taught similar science concepts over the same twelve week period using the Full Option System Science (FOSS) curriculum, a widely used resource developed by the Lawrence Hall of Science. All teachers involved in the study received intensive training on the use of the FOSS curriculum. Treatment teachers received an additional two weeks of training on the Navajo Supplemental Science Curriculum (NSSC). Integration of elements of Navajo cultural content from the NSSC into treatment teachers' science instruction constituted the treatment intervention. Gilbert found that the treatment students scored significantly higher on achievement tests and attitude surveys given one week post instruction compared to the control students, and concluded that CCI instruction was efficacious in supporting increased student achievement and improved attitudes toward science for Navajo students.

In mathematics, Hilberg, Tharp, & Degeest (2000) conducted a small scale study with twenty four 8th grade American Indian students. Treatment group students (N=14) were taught using instructional methods that aligned with the Center for Research on Equity and Diversity in Education (CREDE) Standards for Effective Pedagogy and Learning (CREDE, 2010). Control group students (N=10) were taught using mainstream traditional instructional methods. In this study, the CREDE standards-based methods employed included teacher modeling with small groups of students who engaged in productive dialogue and collaborated in the creation of meaningful products. The quasi experimental study used random assignment and a non equivalent control group design. Statistical analysis of student test scores on proximal achievement tests administered immediately post instruction did not show statistically significant differences in achievement between treatment and control students. However, the treatment group students attained significantly higher scores than control group students on both a mathematics content knowledge retention test and on surveys of attitudes towards math

completed three weeks post instruction, thus providing evidence for the efficacy of CCI in improving American Indian students' mathematics retention and attitudes toward mathematics.

Calls for Increased Research on CCI

The small but promising body of research on CCI in mathematics and science education for diverse students described previously and the increasingly prominent agenda for equitable educational outcomes for all students support the push for greater study of CCI. Individual scholars in the field of education have amplified their advocacy for CCI related research in recent years (See, for example, Penfield & Lee, 2010; Lipka, Sharp, Adams & Sharp, 2007; Lee, 2005). National organizations are also emphasizing the need for more research on CCI (For example, see the Committee on Equal Opportunities in Science and Engineering, 2009; NCTM Achievement Gap Task Force, 2004). NCTM has come out strongly in favor of increasing CCI related research. Recommendation #2 on research from the Achievement Gap Task Force report reads

> NCTM should take a prominent position in support of research related to closing the achievement gap and ensuring that it is addressed at NCTM meetings and conferences at all levels. This research should go beyond suggesting causal relations between underachievement and racial/ socioeconomic identity to investigate the social, political, and cultural issues that contribute to causing and closing the achievement gap (p. 8)

A number of agencies and individuals have specifically identified the need for additional research in CCI for American Indian students as a step toward closing the long standing achievement differential experienced for these cultural groups. For example, the Committee on Equal Opportunities in Science and Engineering convened by the National Science Foundation recommended in their 2008 Biennial Report to Congress (2009) called for an increase in evaluation and research on American Indian education issues including the identification of "elements that are effective in producing successful Native American education programs" (p. 33).

The Challenges of Assessing CCI

The inherent specificity of the elements of CCI by cultural context creates challenges for conducting research in CCI because the assessment instruments and methods employed must align with the specifics of the prioritized culture and elements of CCI relevant to that culture. Many of the instruments and methods for assessing CCI found in the research literature were developed by each study's author(s) specifically for their cultural context and so cannot be assumed to be suitable for use in other contexts. In the case of surveys, this may mean that instrument items are not relevant (or are even taboo) in a different cultural context or that essential items for additional contexts are absent in the survey. These pitfalls may also hold true for classroom observation protocols. The usefulness of protocols can further be inhibited by the limited availability of trained observers with the depth of knowledge required to make informed observations in a specific cultural context.

On the other end of the spectrum, the generalizability of an instrument, a characteristic commonly viewed as an asset in instrument development since it can extend an instrument's usefulness across contexts, can also limit the sensitivity of an instrument. In particular, items

designed to be generalizable across cultural contexts can limit an instrument's ability to provide useful information about specific elements relevant to an individual culture and/or study. The development of instruments that are specific to a culture and that are comprehensive in addressing a particular study's research questions requires deep knowledge and consideration of both the culture and the nature of the study and its research questions.

Methods for assessing CCI also have limitations. Strategies appropriate to and useful in one culture may not be compatible with the norms of another culture (for example, an unfamiliar interviewer trying to conduct interviews with tribal elders with whom they have no prior relationship) or may not be logistically feasible (for example, using online surveys with subjects who may have limited experience in using or limited access to the Internet). Language differences between assessor and assessee may also threaten the validity of assessments, for example, by hindering the assessee's ability to interpret survey items or by limiting their ability to provide meaningful responses to focus group or interview questions. Incongruencies in language can seriously limit the usefulness of research methods that are heavily language dependent.

The study described in this paper grew out of a research priority to evaluate the efficacy of CCI in supporting science achievement for students from five Montana tribal cultures whose teachers were participating in a professional development project aimed at strengthening their culturally congruent science teaching. The design of the study required a means to assess teachers' use of CCI as well as a measure of students' science achievement. Initially, a survey of established instruments already existing in the research literature and designed to assess CCI was conducted. This work revealed an absence of appropriate instruments that would provide culturally specific information of a fine enough grain for the study. Considering this finding and the many other potential types of limitations discussed above, it was deemed imperative to develop and use a CCI assessment instrument and methods that would meet the specific needs of the research to be conducted in this study. While the instrument and methods used here may be compatible in other American Indian contexts to some extent, their use outside of the Montana Tribal cultures for which they were designed will likely require some customization for the specific tribal culture with which they are being used. Even given the potential limitations to generalizability discussed, it is believed that they will have some value in serving as models for instrument and methods development that are useful to others attempting this type of work.

Engaging in Research with American Indian People

In addition to the considerations discussed in the previous section for conducting viable research in CCI, investigators working with American Indian people must also be cognizant of and address a number of other contextual issues in order to ensure beneficial outcomes for (and no harm to) the people with whom they are working and to improve the validity of the research. The history of American Indians' post European contact has been one most often based in hegemony, in which American Indian people have been subjected to treatment as "lesser beings" by European Americans. In the eyes of European immigrants, Native people were most often seen as less civilized, less intelligent, less advanced people, in need of assimilation to not only improve the lives of Indigenous people but to enable the takeover of their resources. Even with their sovereignty guaranteed by treaties, tribal peoples in the United States are, of necessity, continuously working to prevent the erosion of their sovereignty as nations and their rights to self determination. History shows that research and evaluation, particularly education research and evaluation, have commonly been used to subjugate American Indian people, as a means to

provide evidence to justify their assimilation and even their cultural genocide (Chawla-Sahota, 2010). This legacy has understandably created an attitude of mistrust in some American Indian people for research, especially when conducted by cultural outsiders. It magnifies the responsibility of the researcher to work with tribal people in a just and equitable manner and increases the imperative to engage in using participatory methods in which the community and the researcher work together to conduct research in the community.

In order to engage in valid research in Indian country, the researcher must address the cultural norms, values, and epistemologies for the specific context in which they hope to work (LaFrance and Nichols, 2004; Quigley, 2001). This is a challenging charge in Indian Country, given that every tribal culture is unique and every setting is different, and the researcher must not assume that knowledge of one culture can be applied across cultural settings. Specific examples of cultural norms that could influence research in with tribal people are numerous. Working with the Crow people of Montana, for example, requires knowledge of their clan system, of people's relationships within their clan, and the norms for interacting with specific members of a clan. The specific social protocols and communication styles for a cultural group should be known and applied when interacting with Native peoples to assist in building trusting relationships, to foster credibility with stakeholders, and to improve the gathering and interpretation of valid and relevant information that is useful to all stakeholders.

The culturally congruent researcher will engage in the co-construction of knowledge with the people he or she is working (LaFrance and Nichols, 2004; Quigley, 2001). This collaboration raises the large questions of what counts as knowledge for each party involved - what is valued as important information by the Indigenous people as well as the researcher involved in the research - and how is that information gathered and interpreted? The importance of community in tribal cultures and therefore the importance of work that benefits the community means that valuable research for American Indian people is often structured with the big picture in mind, to delineate the effects on and involve the contributions of the whole community, rather than strictly that of individuals. Knowledge that contributes to the preservation of culture is also often identified as a priority.

Scholars involved with Indigenous research have noted that, in many cases, qualitative methods may be more appropriate in engaging in research with tribal people (e.g., LaFrance, 2004). The contextualized story that can emerge using qualitative methods such as case studies, interviews and focus groups, for example, may be more informative for tribal people who strongly value oral history and the importance of context. The limitations on the generalizability of findings, often considered important in making wide use of research, are considered by some to be less important in research in Indian country. Each tribal culture is unique. Generalizing across cultures and settings with any fidelity is difficult and even undesirable.

A holistic philosophy is attributed to many Indigenous peoples (e.g., Deloria and Wildcat, 2001), a stance which emphasizes the reverberating themes of context, relationships, and interactions. The more linear and often reductionist orientation that is commonly held by people of European descent will influence their cultural lens throughout the research process. Reconciling or at least accommodating for differences in worldviews and epistemologies between the researcher and the research participants can pose challenges. Disparities in communication styles and/or language can further confound the process, leading to misinterpretations of ideas and expectations for the research process and its outcomes.

These are just a few examples of culturally based considerations that should be addressed when working with Indigenous peoples. Engaging in effective research with American Indian

people, as with any group of people, requires that the researcher embraces the importance of employing culturally congruent research methods, accept the personal responsibility to develop their knowledge of the cultures they are working with, and put forth the effort to collaborate in conducting culturally congruent research with the specific group of people with whom they are working. The diverse stakeholders involved in the study reported in this paper consciously strove for cultural congruence in this work, as described in the next section.

Methodology

This study used both qualitative and quantitative methods to design the CCIS and begin to establish its validity. The methods employed are described in separate sections below.

Qualitative Methods Employed in Developing the CCIS

Evaluating culturally congruent instruction can be a complex undertaking particularly in ways discussed in earlier sections of this paper. It is also complex in that one must first determine what aspects of CCI will be evaluated and by what means they will be evaluated. For the study described in this paper, it was decided to evaluate teachers' CCI using a survey in which individuals self report on the frequency with which they employ specific culturally competent practices in their science instruction that address the three elements of CCI identified earlier – content, pedagogy and environment. While this method allows comparison across teacher groups and/or over time for the frequency of specific CCI behaviors, it has limitations in that it does not provide qualitative information about the nature of CCI occurring in teachers' classrooms.

The CCI Survey (CCIS) was developed as part of the project evaluation efforts for a science teacher professional project, as one of several means used to evaluate the impacts of the project on teachers' science instruction related practice. The formal process of developing the CCIS began with a literature review. A large body of literature relevant to American Indian culture and culturally competent teaching with American Indian students was pored over and items related to the three areas of CCI (content, pedagogy and instructional environment) were identified and recorded. Research studies and other scholarly writings by experts in American Indian culture and Indigenous education were reviewed. The items commonly identified in the literature as contributing to teachers' CCI with American Indian students were then compiled and formatted into the prototype version of the CCIS.

The main author of this first prototype of the instrument was a non Indian woman who had worked at that point for fifteen years as a science educator in the Flathead Reservation tribal secondary school and tribal college. During that time she had built close relationships with tribal members with whom she had worked extensively in these educational settings. She collaborated with four of these local tribal consultants to revise the prototype instrument items and format to improve its clarity, accuracy, and ease of use. Meetings for revising the instrument were informal and often were one on one but occasionally in groups of three, and were commonly conducted after sharing a meal. Two of the tribal collaborators were women who were members of the Salish tribe of northwestern Montana. One was a 65 year old elder who had worked in many different jobs with the tribes, including as a paraprofessional in the tribal secondary school and as a tribal cultural specialist. The other was a 50 year old tribal educator who had held many prestigious positions in tribal education, two degrees in education, and was well known in the state for her expertise and advocacy in Indian education. The other two collaborators were members of the Kootenai band of northwestern Montana, a man and a woman. The Kootenai woman was a 63 year old elder who had also held many different positions as a tribal employee

and was currently acting as a designated cultural representative for the Kootenai people, particularly in educational settings. The Kootenai man was a Kootenai language specialist who worked for the Kootenai Elders Committee and held advanced degrees in Native studies and education. Each person contributed suggestions for improving the instrument's content and layout, which were then incorporated into the first prototype. The resultant survey was a 34 item instrument that utilized a 4 point Likert type scale. This first prototype of the CCIS was piloted with the project's first cohort of treatment teachers; data were analyzed using statistical tests described later in this paper. Results were used to refine the next generation instrument.

The next step taken in the development process occurred six months later at a two day meeting with representatives from every party of stakeholders involved in the professional development project – tribal consultants from each tribe involved in the project (Northern Cheyenne, Crow, Salish, Kootenai, and Lakota), project leadership, project professional developers and classroom mentors, Indian and non Indian K-8 classroom teachers, an external evaluator who was American Indian, non Indian science and science education faculty and non Indian and Indian graduate students in science education. This meeting of stakeholders provided important input from the tribal people with whom the instrument would be used which helped to ensure that the instrument was culturally congruent and had face validity for those tribal cultures. It also provided opportunities for input from the project staff, many of whom were educators. Their feedback helped improve the usefulness of the CCIS by ensuring that it was designed to address important aspects of classroom instruction. The group was a well balanced mix of Indian and non Indian people and professional educators and non educators, many of whom knew each other in advance of the meeting; this was done deliberately to help create a nonthreatening environment for all that would enable candid conversation. The meeting lasted two days and was held in a hotel conference room. The extended length of the meeting allowed time for the group to become comfortable with the meeting venue and to "bond" as a group. Most of the group stayed overnight at the meeting hotel and everyone ate meals together, a culturally competent practice that was also deliberately observed. These types of details to the meeting's format enabled group members to become more comfortable with conversing openly with each other and provided extensive opportunities for participants to think deeply about CCI and related topics, thereby supporting members in sharing their personal and professional experiences and thoughts on these topics.

The external evaluator who facilitated the meeting conversation was carefully chosen for her extensive evaluation experience in Indian Country and her known expertise in facilitating emergent conversations using participatory processes. She began the meeting by facilitating an open ended conversation with all participants about the meaning of culture and significance of CCI, then she slowly moved the group toward discussing the nature of CCI for the specific Tribal communities involved and how CCI would look in K-8 classrooms, particularly in science instruction. Participants were seated around tables arranged in one large U shape, with the evaluator in the middle of the U. There was no interview protocol employed or formal rules for speaking, although the evaluator did consult with the project leadership in advance of the larger meeting to discuss the meeting's objectives, and then again during breaks in the meeting as touch points to assess the usefulness of the information gathered and to consider possible additional topics. The format of the meeting was similar to that of a "Talking Circle", in which any participant was welcome but not obligated to speak. Protocols for Talking Circles can vary with specific tribal cultures, but generally they are semi structured, naturally flowing, informal conversations focused on a central topic and related ideas. Participants are free to contribute

when they feel that they have something important to say, and are allowed to speak as long as they desire without interruption. Elders and other highly respected participants often speak first in Talking Circles. This type of format is a thorough and egalitarian one often used in American Indian settings, and can be very time consuming compared to more structured meetings that follow an agenda and are pushed along so that all items are addressed in a timely manner. The extra time sometimes associated with a Talking Circle is time well spent in attaining objectives like those of this phase of the CCIS development; the open ended nature of the Talking Circle enables ideas to emerge naturally from the conversation, often with more depth than could be achieved in a more structured format. For the development of the CCIS, this format was particularly effective given the diversity of the stakeholders and the objective of defining and operationalizing the construct of CCI for the specific cultures and contexts involved. Several of the university faculty participating in the project had limited familiarity with the construct and with the tribal cultures involved in the project, so the thoroughness of the meeting's conversation served to deepen their personal understanding of these things and provided extensive information valuable to furthering the development of the CCI.

The meeting's discussion was recorded in two ways. The evaluator wrote brief notes about emergent ideas on a large chart for all participants to see. The project director meanwhile recorded the points of conversation by typing them on a laptop computer. On the evening of the first meeting day, the notes from the conversation of the first day long meeting were reviewed by the evaluator to identify overarching themes and subjects that could be probed to provide further information. On the second day she approached the group with four teaching scenarios that emerged from the previous day's conversation that characterized the professional development project and whose deeper examination she felt would provide additional valuable information. Those four scenarios were:

1. American Indian teachers teaching mostly American Indian students of the same culture in reservation schools
2. American Indian teachers from a different culture teaching mostly American Indian students in reservation schools
3. Non Indian teachers teaching mostly American Indian student in reservation schools
4. Non Indian teachers teaching mostly non Indian students in off reservation schools

These scenarios provided fodder for the second day's conversation as the whole group engaged again in the informal Talking Circle-like format and discussed the differences in CCI expected for each scenario. About midway through the second day of meetings the evaluator shared the prototype CCIS with the meeting participants and solicited their feedback on the instrument. The resultant ideas from the two day discussion were used by the primary author of this study to modify the instrument items for a second generation prototype referred to as the Revised CCIS.

Over the next two months, the evaluator conducted smaller focus groups with subsets of teacher participants involved in the professional development project from each of its remaining partner sites. The teacher participants in the focus groups were selected by the project leadership at each site based on their perceived advanced level of cultural competence compared to their peers. One meeting was held on a reservation with teachers who all taught in reservation schools with high percentages of American Indian enrollment. The other meeting was held off reservation with teachers who all taught in schools located off but near a reservation and whose American Indian student enrollments were low. These focus groups utilized a semi structured

interview protocol whose questions were designed to address important issues that emerged from the original two day meeting. The focus group questions are available in the appendices to this paper. About midway through the focus groups the evaluator shared the list of CCI attributes identified by the participants in the two day meeting and asked the focus group participants to compare this list with the one that they had brainstormed during their focus group. The ideas generated in both focus groups were then used by the primary author of the instrument to further modify the items that comprised the Revised CCIS.

The next step for the development of the CCIS was to engage in member checking of the revised instrument. The primary author met face to face with several members of the original two day meeting group to go over the instrument items. The CCIS items were checked for face validity, inclusiveness, bias, clarity of the language, and accuracy in portraying the ideas that emerged from the instrument development meetings. Additional feedback was garnered via e mail communications, both with people who participated in the three meetings (the two day meeting plus the two focus groups) and from three people outside of the project who did not participate in the meeting but who are recognized experts in American Indian education. The feedback from the face to face meetings and e mail communications were used to once again modify the items on the Revised CCIS. The revisions increased the number of items from 34 items plus one open ended "Other" item that were divided into three categories on the prototype instrument, to 37 items plus 4 open ended "Other" items that were divided into four categories on the revised survey. Language on the Revised CCIS was modified to reflect the feedback received through meetings and e mail, for example, items that previously used the term "American Indian Tribes" now use the term "Montana Indian Tribes". The revised survey was also more clearly delineated into categories with prominent category headings and a short paragraph included beneath each category heading containing explicit directions about how to respond to the category items. These changes can be reviewed by examining the original and revised CCIs in the appendices to this paper.

The analysis of the data from the pilot administration of the original version of the CCIS revealed a number of significant findings regarding positive changes in teachers' cultural competency. Based on the results of the pilot administration, it was decided that a finer grained scale should be employed on the Revised CCIS as a means to try and improve the quality of the survey data collected. The instrument's primary author combed the literature on survey scale design and consulted with three assessment design experts, using the information gathered to develop a new six point scale that was used on the Revised CCIS, replacing the four point scale found on the prototype CCIS.

Quantitative Methods for Analyzing the CCIS and Data

The quantitative methods employed in this study include methods used to analyze data collected from the administration of the CCIS as well as that from other surveys that were administered for use in generating evidence of the validity of the CCIS. The CCIS was developed and is currently being used as one means for assessing teachers' CCIS. This study employs a quasi experimental design, involving non randomized groups of treatment and matched comparison group K-8 teachers. Treatment group teachers are participants in a professional development intervention that is focused on developing science teacher leaders with deepened knowledge of science content, science pedagogy, and culturally competent science instruction. Treatment teachers applied for project membership voluntarily; criteria for teacher selection were based on those correlated with high teacher leadership potential as found in the literature (number of years

teaching, respect of their peers, previous leadership roles, etc.). About half of the applicants were recommended initially by their administrators as high quality teacher leader candidates and were asked to apply and the other half heard about the project from peers and opted to apply on their own. Comparison group teachers were recruited by the professional development project staff based on the characteristics they shared with the treatment teachers such as total number of years in teaching, number of years teaching science, grade levels taught, their ethnicity and gender, their student demographics, the location of their school, and the number of college science courses each had completed. The overwhelming majority of the treatment and comparison group teachers were White. Eighty six percent were female. Both treatment and comparison group teachers were teaching K-8 students in largely rural schools on or near American Indian reservations in Montana. American Indian student enrollments in the partner schools ranged from 0 to 100%. Half of the teachers were teaching in schools in which American Indian students constituted at least 41% of their student enrollment. One in five teachers taught in schools with American Indian student enrollments exceeding 80%. Tables 1 through 5 below give specific numbers for the characteristics of the 128 teachers and their schools that were involved in this study.

Teacher Ethnicity	Number of Study Teachers	Percentage of Study Teachers
Asian American	3	2
Mixed American Indian/Alaska Native/White	2	2
American Indian/Alaskan Native	16	13
White	107	84

Table 1 – Teacher ethnicity as self identified by treatment and comparison group teachers

Location of School	Number of Study Teachers	Percentage of Study Teachers
On an American Indian reservation	69	54
In a border town, serving American Indian students	11	9
Rural - off reservation	17	13
Urban/Suburban	31	24

Table 2 – Location of schools in which study teachers taught

Percent American Indian Student Enrollment	Percentage of Schools
1 to 20	38
21 to 40	12
41 to 60	6
61 to 80	24
81 to 100	20

Table 3 – Percent American Indian enrollment in treatment and comparison group schools

Total Years Teaching	Number of Study Teachers	Percentage of Study Teachers
Less than 1 year	4	3
1 to 2 years	21	16
3 to 5 years	34	27
6 to 8 years	19	15
9 to 11 years	8	6
12 to 15 years	17	13
More than 15 years	25	20

Table 4 – Total years as a teacher for treatment and comparison group teachers

Total Years Teaching Science	Number of Teachers	Percentage of Teachers
Less than 1 year	6	4
1 to 2 years	11	9
3 to 5 years	22	17
6 to 8 years	25	20
9 to 11 years	14	11
12 to 15 years	12	9
More than 15 years	38	30

Table 5 – Total years of science teaching for treatment and comparison group teachers

The prototype CCIS was administered to treatment teachers in spring 2007, prior to their participation in the professional development intervention. Data from this administration was used in various ways, including in improving the rating scales used on the Revised CCIS. The Revised CCIS was administered a series of four times to both treatment and comparison group teachers beginning in spring 2008 and annually each year through spring 2010.

Results

Factor Analysis of the Revised CCIS

Factor analysis of the revised CCIS revealed a total of ten constructed factors, with Cronbach's alphas ranging from .81 to .48. Results of the factor analysis and the scale constructions are summarized in Table 6 below. The Revised CCIS can be found in the appendix of this paper for referencing the items in each factor.

Internal Reliability Analyses for the Pre and Post CCIS

Internal reliability analyses for the Pre and Post CCIS resulted in Cronbach's alphas of .940 and .955 respectively, providing evidence of high internal consistency for these two instruments.

Rank	Scale Mean	Factor Number	Alpha	Factor Name	CCIS Items
0	0.1885	NA	.88	37-Item Average	All 37 items
1	0.3294	3	.78	Biases Examined	35-37, 40
2	0.2698	2	.81	Curriculum Content	1-3, 5-6
3	0.2693	5	68	Performance Evaluations	12-14, 17
4	0.2110	8	.50	Student Generated Learning/Design	10, 15, 18
5	0.2055	7	.69	Tribal Elders Consulted	38-39
6	0.1891	1	.80	Classroom Resources	24-25, 27-31
7	0.1411	4	.69	Enhancing Learning/Teaching Environment	9, 19, 20-22
8	0.1158	6	.53	Native American Language & Contact	4, 11, 16, 26
9	-0.1972	9	.48	Parent & Student Conferences	33-34
10	0.0889	10	NA	Collaborative Groups	8

Table 6 – Results of the factor analysis and internal consistency analysis for the revised CCIS for all 37 scaled items. The instrument also includes four open ended items that were not part of this analysis. N= 128

Paired Correlations for Pre and Post CCIS Scores

Table 7 below shows the paired samples statistics and correlations for the pre and post CCIS scores for each of the 10 constructed factors and a single item factor. Paired samples correlations of pre and post test scores uncovered statistically significant correlations for every factor, including an overall 37 item factor ($p < .001$), indicating that pre and post survey scores for individuals were highly correlated.

		Mean	Standard Deviation	Standard Error of the Mean	Correlation
Pair 1	Factor 3 Post	2.9082	1.32148	.11680	.641**
	Factor 3 Pre	2.5788	1.21015	.10696	
Pair 2	Factor 2 Post	2.5969	.89928	.07949	.635**
	Factor 2 Pre	2.3270	.83265	.07360	
Pair 3	Factor 5 Post	3.6610	1.02286	.09041	.642**
	Factor 5 Pre	3.3918	.93648	.08277	
Pair 4	Factor 8 Post	3.2656	.95605	.08450	.632**
	Factor 8 Pre	3.0546	.88587	.07830	
Pair 5	Factor 7 Post	1.9409	1.03361	.09136	.675**
	Factor 7 Pre	1.7353	1.02934	.09098	
Pair 6	Factor 1 Post	2.6282	.98727	.08726	.625**
	Factor 1 Pre	2.4391	.92462	.08173	
Pair 7	Factor 4 Post	3.4201	.92129	.08143	.566**
	Factor 4 Pre	3.2790	.83225	.07356	
Pair 8	Factor 6 Post	2.0110	.82212	.07267	.694**
	Factor 6 Pre	1.8951	.80936	.07154	
Pair 9	Factor 10 Post	4.2762	1.06866	.09446	.618**
	Factor 10 Pre	4.1873	1.18892	.10509	
Pair 10	Factor 9 Post	2.9257	1.03017	.09106	.490**
	Factor 9 Pre	3.1229	1.08173	.09561	
Pair 11	Factor Overall Post	2.8813	.75302	.06656	.760**
	Factor Overall Pre	2.6928	.66428	.05871	

Table 7 – Paired sample statistics and correlations for the 9 constructed scales, the overall scale and the single item scale for the CCIS. N= 128 ** Correlation is significant at $p \leq .001$

Paired t Tests for Pre and Post CCIS Scores

Paired t tests were run on the differences in pre and post CCIS scores; results are shown in Table 8. Results of the analysis show statistically significant pre-post gains ($p \leq .05$) for treatment teachers on nine of the ten survey scales, suggesting that the intervention positively impacted their CCI. Factor 10, Collaborative Groups, shows some gain at post-test, but is not significant at the $p \leq .05$ level. Factor 9, the 2-item Parent & Student Conferences, is negative, indicating that post-test scores dropped significantly for this factor.

Factor		Mean	Standard Deviation	Standard Error Mean	t	df	Significance (2-tailed)
Pair 1	Factor 3	.32939	1.07781	.09527	3.458	127	.00074
Pair 2	Factor 2	.26984	.74252	.06563	4.112	127	.00007
Pair 3	Factor 5	.26926	.83253	.07359	3.659	127	.00037
Pair 4	Factor 8	.21101	.79282	.07008	3.011	127	.00314
Pair 5	Factor 7	.20552	.83165	.07351	2.796	127	.00598
Pair 6	Factor 1	.18908	.82934	.07330	2.579	127	.01104
Pair 7	Factor 4	.14105	.82048	.07252	1.945	127	.05399
Pair 8	Factor 6	.11582	.63841	.05643	2.053	127	.04217
Pair 9	Factor 10	.08891	.99234	.08771	1.014	127	.31268
Pair 10	Factor 9	.19716	1.06734	.09434	-2.090	127	.03863
Pair 11	Factor Overall	.18850	.49813	.04403	4.281	127	.00004

Table 8 – Paired samples t tests on differences in pre and post CCIS scores for all 11 factors. ($p \leq .05$)

Test – Retest Analysis

In addition to the annual spring administration of the CCIS, the revised instrument was also administered to treatment teachers in summer 2009, within six weeks of the spring administration, to provide data for a test-retest measure of reliability. Pearson's Correlation Coefficient for the Spring and Summer CCIS administrations was found to be $r = .741$, significant at the $p \leq .000$ ($N = 68$). This analysis was run using only the 29 items that were common to both the prototype and Revised CCIS.

Convergent Evidence of Validity

Two additional surveys designed to assess CCI and identified in the literature were also administered to 118 of the 128 treatment and comparison group teachers one time concurrently with the revised CCIS, as a means of gathering data that might provide evidence of the instrument's construct, predictive and concurrent validity. The Teacher Multicultural Attitude Survey or TMAS (Ponterotto, et. al., 1998) and the Culturally Responsive Teaching Self Efficacy Scales or CRTSES (Siwatu, 2006) were chosen from a review of instruments for their relevance to this study and for the quality of the evidence the authors provided of their validity. The constructs addressed in the TMAS and CRTSES, multicultural attitudes and teacher self efficacy, are thought to be related to CCIS. Internal reliability analysis conducted on the two validation surveys by the authors of the present study indicated high internal consistency for both surveys with Cronbach's alphas of .846 and .974 respectively, very similar to those reported in the literature by the instruments' authors. The authors of the TMAS also reported a test-retest Pearson's correlation of .80.

Table 9 shows the descriptive statistics for four survey data sets – the TMAS, CRTSES, and Post CCIS, all administered concurrently, as well as the Pre CCIS. Table 10 lists the correlations coefficients for each of the four data sets. As can be seen in the table, the Pre and Post CCIS show strong correlations while the TMAS and CRTSES each show moderate correlations with each other and with the Pre and Post CCIS. All correlations are statistically significant for a two tailed test at the $p \leq .01$ level.

Survey	Mean	Standard Deviation
Pre CCIS	2.7135	.67349
Post CCIS	2.9125	.76874
TMAS	3.3411	.68257
CRTSES	4.0653	.36230

Table 9 – Descriptive statistics for the Pre and Post CCIS and two validation surveys. N = 118

Survey	Pre CCIS	Post CCIS	TMAS	CRTSES
Pre CCIS	1	.769**	.481**	.404**
Post CCIS	.769**	1	.494**	.456**
TMAS	.481**	.494**	1	.509**
CRTSES	.404**	.456**	.509**	1

Table 10 – Pearson Correlation Coefficients for the Pre and Post CCIS and two validation surveys. N = 118. ** Correlation is significant $p \leq 0.01$ level (2-tailed).

Factor analyses conducted on the TMAS and CRTSES data revealed that they are comprised of 5 and 6 scales respectively. Future analyses will be conducted to determine the extent to which these subscales on each of the validation surveys correlate with the 10 scales on the Pre and Post CCIS, thus providing additional evidence of predictive and concurrent validity respectively for the CCIS.

Influence of Demographic Variables

Eleven stepwise regressions were also run to determine the influence of fourteen teacher demographic variables on the extent and direction of pre-post-post changes on the total 37 item CCIS scale scores as well as on the 10 specific factor scores comprising the overall construct. Nine of the variables appeared in the 11 regression equations as important influences on the CCIS scores. The two strongest predictor variables were found to be membership in the treatment group (appearing in 8 of the 11 equations) and years teaching science (appearing in 4 of the 11 equations). Further details of the results of this analysis can be found in the appendices.

Discussion

This study describes one model for developing an assessment instrument using a culturally congruent participatory process. The methods used were deliberately designed to engage the study's diverse research participants in a culturally congruent manner to enable the solicitation of valid and reliable information that was integral to developing the instrument. The identification of key community participants and time spent developing relationships with them, the inclusion of all stakeholders in an informal and non threatening dialogue, the use of expert personnel to facilitate that dialogue, the participant centeredness of the conversations, the deliberate and protracted nature of the meetings, the attention to the physical format that provided a

comfortable and equitable setting, the sequence and duration of the meetings that enabled the development of a trusting atmosphere, the honoring of people's input by incorporating into the instrument design, the iterative nature of the process through member checking and garnering the input of a wide range of experts throughout the many stages of the development process, as well as the grounding of the instrument in the literature and a theoretical framework should all contribute to the instrument's validity. The high degree of consensus among stakeholders about the quality and comprehensiveness of the instrument items in operationalizing CCI for the prioritized cultures further contributes to its validity. While the methods used for this study may not be congruent across cultural contexts, it serves as one model for the use of culturally congruent and participatory practices for conducting research in Indigenous communities, and particularly for instrument development.

The quantitative aspects of this study provide preliminary evidence for the validity of the CCIS in assessing teachers' classroom practice and valuable information that can be used to improve the instrument and its future use. The high Cronbach's alpha found for the CCIS offers evidence of its internal reliability. The factor analysis revealed nine multi item factors plus one single item factor that comprise the instrument and account for 62% of the variance. The high correlation coefficient resulting from the test-retest data provides additional evidence of the instrument's internal reliability. The high correlation values for each of the Pre and Post CCIS factor scores are indicators of their predictive validity. The moderate correlation coefficients for the validation surveys (TMAS and CRTSES) with the Pre and Post CCIS supply preliminary convergent evidence of the validity of the CCIS. These multiple forms of evidence are indicators of the validity and value of the CCIS for assessing teachers' CCI.

Information gained from this study and planned future research (see below) afford useful guidance for designing future professional development efforts and research on CCI. The stepwise regressions with the teacher demographic variables and the CCIS scores, for example, supply clues to the variables that influence the development of teachers' CCI. Knowledge of these variables and their influence on CCI offer guidance for the design of interventions that will build on and/or accommodate for these characteristics. The authors of this paper intend to continue this line of research in a number of ways, including analysis of the subscales of the three surveys used previously (the CCIS, the TMAS and the CRTSES) to gain additional information about their correlations and to provide additional convergent and/or discriminant evidence of validity.

Conclusions and Recommendations for Future Research

As stated earlier in this paper, the purpose of developing the CCIS was to provide an instrument that could be used to further the research regarding the efficacy of CCI in increasing American Indian students' science achievement. This study has provided preliminary evidence of the quality and value of the CCIS for this purpose. As more data are collected through the continued use of the CCIS, further analysis will be conducted and the results will be to establish additional evidence of its validity and to optimize the instrument further.

While the CCIS is designed to allow the quantification of the frequency of specific instructional behaviors that have been identified as integral to CCI in the five prioritized cultural contexts, it does not provide information regarding the *nature* of the CCI practices in question. So, for example, a teacher may self report that he/she frequently includes cultural content in the form of contemporary tribally relevant science issues in their lessons, but there is no indication of the specific types of issues addressed, their significance to the tribal community in question,

or the nature of the strategies used to study the issues or the depth of the instruction in the. This limits the researcher's ability to evaluate the correlation between the specific cultural content taught and its impacts on student achievement.

Finally, the CCIS's use of teacher *self report* of instructional content and practices potentially introduces teacher bias for which the researcher cannot compensate without additional information. Additional types of classroom behaviors data that could be triangulated with the CCIS data to provide a richer picture of classroom instructional practices, thus allowing greater confidence in the research findings, a deeper understanding of teachers' CCI, and ultimately enabling a more rigorous evaluation of the impacts of CCI on student achievement. At this time there is a dearth of such instruments, unfortunately. The authors of this study have begun the complex undertaking of the development of two such instruments, a classroom observation protocol and teacher portfolio designed to assess CCI, and hope to continue this work in future research efforts.

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Appendix A

Culturally Congruent Instruction Prototype Survey

Please indicate how often you included each of the following items in your science instruction during the 2006-'07 school year.

151) Traditional stories from local Tribes

Never O Rarely O Sometimes O Often O

152) Content about contemporary local Tribal issues

Never O Rarely O Sometimes O Often O

153) Historical content about local American Indian Tribes

Never O Rarely O Sometimes O Often O

154) A fieldtrip to a cultural site significant to local American Indian Tribes

Never O Rarely O Sometimes O Often O

155) Visit by a Tribal member to your class to share cultural information

Never O Rarely O Sometimes O Often O

156) Contact a Tribal member to obtain culture related information or resources

Never O Rarely O Sometimes O Often O

Please indicate how often you had each of the following items accessible to students in your classroom during the 2006-'07 school year.

157) Age appropriate books about local Tribal cultures

Never O Rarely O Sometimes O Often O

158) Bulletin boards/displays that include cultural content

Never O Rarely O Sometimes O Often O

159) Posted words or phrases in local Native languages

Never O Rarely O Sometimes O Often O

160) American Indian music

Never O Rarely O Sometimes O Often O

161) Locally made American Indian crafts or art work

Never O Rarely O Sometimes O Often O

162) Pictures or videos that reflect local Tribal cultures

Never O Rarely O Sometimes O Often O

163) Other (Please specify.) _____

Please indicate how frequently you used each of the following strategies or items in your science instruction during the 2006-'07 school year.

164) Collaborative learning groups

Never O Rarely O Sometimes O Often O

165) Strategies chosen to address diverse learning styles

Never O Rarely O Sometimes O Often O

166) Strategies that assist learners who are Limited English Proficient (e. g., frequent use of graphics, models, other visuals; moving from concrete to abstract; contextualized use of vocabulary)

Never O Rarely O Sometimes O Often O

167) Alternative assessment

Never O Rarely O Sometimes O Often O

168) Local Native language

Never O Rarely O Sometimes O Often O

169) Formative assessment with direct feedback to students

Never O Rarely O Sometimes O Often O

170) Private one on one teacher-student discussion of student learning

Never O Rarely O Sometimes O Often O

171) Examination of content for cultural bias

Never O Rarely O Sometimes O Often O

172) Extended wait time

Never O Rarely O Sometimes O Often O

173) Interaction with every student's parents or guardians

Never O Rarely O Sometimes O Often O

174) Working with Tribal elders or other community member as guest teachers

Never O Rarely O Sometimes O Often O

175) Mentoring of students by adults other than the classroom teacher

Never O Rarely O Sometimes O Often O

176) Opportunities for private practice precede public demonstration of proficiency

Never O Rarely O Sometimes O Often O

177) Practical application of science knowledge by students in classroom activities

Never O Rarely O Sometimes O Often O

178) Art based instructional methods (e.g., metaphors, storytelling, music, etc.)

Never O Rarely O Sometimes O Often O

179) Examination of instructional methods for cultural bias

Never O Rarely O Sometimes O Often O

180) Examination of instructional content for cultural bias

Never O Rarely O Sometimes O Often O

181) Teaching core science content using a local or place based context

Never O Rarely O Sometimes O Often O

182) Teaching American Indian traditional science knowledge along with Western science content

Never O Rarely O Sometimes O Often O

183) Open ended problem based learning

Never O Rarely O Sometimes O Often O

184) Observational learning strategies (e.g., adult or peer modeling, demonstrations, apprenticeships)

Never O Rarely O Sometimes O Often O

185) Local Native language in instruction and interactions with students

Never O Rarely O Sometimes O Often O

Please indicate how frequently you participated in each of the following activities during the 2008-'09 school year.

186) Planning your school's science professional development

Never O Rarely O Sometimes O Often O

187) Making significant contributions to developing your school's science education program

Never O Rarely O Sometimes O Often O

188) Voluntarily trying out innovative science curriculum content and methods

Never O Rarely O Sometimes O Often O

189) Making decisions about your school's science materials purchases

Never O Rarely O Sometimes O Often O

190) Working collaboratively with colleagues to develop your school's science program

Never O Rarely O Sometimes O Often O

191) Voluntarily sharing math/science instructional activities and resources with your colleagues

Never O Rarely O Sometimes O Often O

192) Working with your school and/or district administrators to improve your school's science instruction

Never O Rarely O Sometimes O Often O

Appendix B

Revised Culturally Congruent Instruction Survey

Section 1: Curriculum Content

Think about your **science instruction** during the 2008-2009 school year. Circle the number in the column that best represents **the percentage of science lessons** in which you used each of the following types of content in your during the 2008-2009 school year.

e.g., For the first item, if you included a traditional story in 25% of the science lessons you taught during 2008-2009 school year, you would circle the number 3 in the "Sometimes" column.

	Never	**Seldom (1 to 20%)**	**Sometimes (21 to 40%)**	**Often (41 to 60%)**	**Very Often (61 to 80%)**	**Almost Always (>80%)**
1) A traditional story from a Montana Indian tribe	1	2	3	4	5	6
2) Contemporary issues relevant to Montana Indian tribes	1	2	3	4	5	6
3) Historical content about Montana Indian tribes	1	2	3	4	5	6
4) A fieldtrip to a site significant to Montana Indian tribes	1	2	3	4	5	6
5) Traditional science knowledge from Montana Indian tribes	1	2	3	4	5	6
6) Science content tied to a place based context relevant to a Montana Indian tribe	1	2	3	4	5	6
7) Other cultural content – Please specify here:	1	2	3	4	5	6

Section 2: Instructional Strategies

Think about your **science instruction** during the 2008-2009 school year. Circle the number in the column that best represents the **percentage of science lessons** in which you used each of the following instructional strategies during the 2008-2009 school year.

	Never	Seldom (1 to 20%)	Sometimes (21 to 40%)	Often (41 to 60%)	Very Often (61 to 80%)	Almost Always (>80%)
8) Had students work in collaborative groups	1	2	3	4	5	6
9) Used extended wait time in conversations with students	1	2	3	4	5	6
10) Encouraged students to assume responsibility for their learning - e.g., students made choices about how they studied a topic, how they were assessed, etc.	1	2	3	4	5	6
11) Local tribal elders or other tribal community members were guest teachers	1	2	3	4	5	6
12) Used teaching strategies that support Limited English Proficient or Second Language learners (e. g., used graphics, models, other visuals; moved from concrete to abstract; made frequent contextualized use of vocabulary)	1	2	3	4	5	6
13) Used alternative forms of assessment like authentic assessment, or performance based assessment (instead of multiple choice, fill in the blank, e.g.)	1	2	3	4	5	6
14) Provided specific formative feedback to each student	1	2	3	4	5	6
15) Used metaphors, analogies, or symbols to represent science content	1	2	3	4	5	6

Section 2: Instructional Strategies - Continued

	Never	Seldom (1 to 20%)	Sometimes (21 to 40%)	Often (41 to 60%)	Very Often (61 to 80%)	Almost Always (>80%)
16) Used local Native language in instructional interactions with students	1	2	3	4	5	6
17) Provided ample opportunity for students to engage in private practice before publicly demonstrating their proficiency	1	2	3	4	5	6
18) Used science activities in which students designed solutions to problems relevant to the their community	1	2	3	4	5	6
19) Supported mentoring of students by adults other than the classroom teacher or paraprofessionals	1	2	3	4	5	6
20) Used art based teaching methods (e.g., storytelling, music, drawing, painting, poetry, drama, etc.)	1	2	3	4	5	6
21) Used observational learning strategies (e.g., adult or peer modeling, demonstrations, apprenticeships)	1	2	3	4	5	6
22) Was flexible with time (e.g., changed scheduling of instruction to meet individual students' needs)	1	2	3	4	5	6
23) Other instructional strategies for teaching ethnically diverse students– Please specify here:	1	2	3	4	5	6

Section 3: Classroom Resources Accessibility

Think about your **classroom environment** during the 2008-2009 school year. Circle the number in the column that best represents **the percentage of school days** that each of the following resources were **accessible** to students in your classroom during the 2008-2009 school year.

	Never	Seldom (1 to 20%)	Sometimes (21 to 40%)	Often (41 to 60%)	Very Often (61 to 80%)	Almost Always (>80%)
24) Age appropriate books about Montana tribal cultures	1	2	3	4	5	6
25) Bulletin boards or displays that included content from Montana Indian cultures	1	2	3	4	5	6
26) Posted words or phrases written in local Native languages	1	2	3	4	5	6
27) Music from Montana Indian tribes	1	2	3	4	5	6
28) Tools, crafts or art work made by members of Montana Indian tribes	1	2	3	4	5	6
29) Pictures or videos of Montana Indian cultures	1	2	3	4	5	6
30) Games and toys from Montana Indian cultures	1	2	3	4	5	6
31) Web sites or software about Montana Indian cultures	1	2	3	4	5	6
32) Other culturally relevant resources – Please specify here:	1	2	3	4	5	6

Section 4: Additional Education Related Practices

This last section of the survey asks you to again think about the 2008-2009 school year. Circle the number in the column that best represents **how many times during the school year** you engaged in each of the practices listed below.

	Never	1 to 2 times per year	3 to 4 times per year	5 to 6 times per year	7 to 8 times per year	9 or more times per year
33) Communicated with every student's parents or guardians to discuss their student's progress	1	2	3	4	5	6
34) Held a private conference with each student to discuss their progress	1	2	3	4	5	6
35) Examined instructional methods for cultural bias	1	2	3	4	5	6
36) Examined instructional content for cultural bias	1	2	3	4	5	6
37) Examined your classroom environment and management for cultural compatibility with your American Indian students	1	2	3	4	5	6
38) Consulted with tribal elders, culture committees, or other tribal community members about content relevant to Montana Indian tribes	1	2	3	4	5	6
39) Consulted with tribal elders or other tribal community members about classroom management or instructional strategies	1	2	3	4	5	6
40) Examined your science curriculum to see how well it addresses the "Essential Understandings About Montana Indians"	1	2	3	4	5	6

41) Other education related practices that address ethnic diversity – Please specify here:	1	2	3	4	5	6

Appendix C

Focus Group Protocol

1. What are the attributes of a culturally competent teacher?
2. How do the attributes of cultural competence translate into practice?
3. How has your membership in this project influenced you in terms of the attributes and practice of cultural competence?
4. Which is most important to developing cultural competence?
5. How has the project influenced your working with other teachers?
6. Have you had any experiences that were not supportive of your project related work?
7. What units/lessons would you want to share that you either really liked or didn't?
8. What has been most challenging about teaching science in a culturally competent manner?
9. What other advantages have you enjoyed from your experiences in the project?
10. Please compare the two lists (The list distributed from previous meetings with partners and the one that was generated during this meeting)
11. What has occurred in the project that has supported your growth in cultural competence?
12. What were the essential elements of Culture Camp that you found helped you?
13. What is the most significant element of the project for your teaching?
14. What elements of the project would you let go?
15. What elements do you want more of?
16. What other questions should we be asking, or evidence should we be collecting in our research on cultural competency?

Appendix D

CCIS Factors	Mean Difference	Predictor 1	Predictor 2	Predictor 3	Predictor 4	% Variance explained
Overall CCIS Factor	0.1885	Treatment Group	Total years teaching science			3% to 5%
Factor 3 - Biases Examined	0.3294	American Indian teacher	Treatment group			3% to 5%
Factor 2 -Curriculum Content	0.2693	Treatment Group	Total years teaching science			3% to 6%
Factor 5 - Performance Evaluations	0.2693	Treatment Group	Female teacher			7% to 9%
Factor 8 - Student Centered Learning	0.2110	American Indian teacher *	Elementary teacher			2% to 4%
Factor 7 - Elders Consulted	0.2055	Cohort group (cohort 2)				1.6%
Factor 1 - Classroom Resources	0.1891	Teaching environment	Total years teaching science	Female teachers	Treatment group	9% to 14%
Factor 4 - Learning environment	0.1411	Reservation/ Border town	Total years teaching			3% to 5%
Factor 6 - Native Language & Contacts	0.1158	Treatment Group				1.7%
Factor 9 - Parent & Student Conferences**	-0.1972	Total years teaching science	Treatment Group			3% to 5%
Factor 10 - Collaborative Groups	0.0889	Treatment Group	Cohort Group (cohort 2)			3% to 6%

This table shows the results of eleven stepwise regressions conducted to elucidate the influence of teacher demographic characteristics on their CCI

* American Indian teachers tended to decline in ratings of these items, while Elementary teachers practices increased

** These items declined from the pre-to post-test, the only factor to exhibit an overall decline