The Significance of a K-12 Diabetes-Based Science Education Program for Tribal Populations: Evaluating Cognitive Learning, Cultural Context, and Attitudinal Components

Journal of Health Disparities Research and Practice

Volume 3 | Issue 3 Article 6

2009

The Significance of a K-12 Diabetes-Based Science Education Program for Tribal Populations: Evaluating Cognitive Learning, Cultural Context, and Attitudinal Components

Carolee D. Francis , *University of Nevada, Las Vegas*, carolee.dodgefrancis@unlv.edu
Doug Coulson , *PS International*
Bonnie Kalberer , *National Institutes of Health*

See next page for additional authors

The Significance of a K-12 Diabetes-Based Science Education Program for Tribal Populations: Evaluating Cognitive Learning, Cultural Context, and Attitudinal Components

Abstract

Preventing and reducing the onset of type 2 diabetes among American Indian/Alaska Native youth requires ground-breaking strategies to affect knowledge, attitudes, and cognitive decision-making skills. In an unparalleled endeavor to address the growing epidemic of type 2 diabetes in tribal communities, a K-12 Diabetes Education in Tribal Schools (DETS) curriculum was created by eight tribal colleges and three federal agencies. This article highlights the results of the implementation phase, the final evaluation step in acquiring and measuring student knowledge and attitude gains through pre-post standardized assessment.

Keywords

American Indian/Alaska Native; Arctic peoples; Culture; Diabetes – Prevention; Education; Health education; Indians of North America; K-12 curriculum; Non-insulin-dependent diabetes – Study and teaching; Tribal schools; Type 2 diabetes; Youth

Cover Page Footnote

In memory of Janet Belcourt, our dedicated leader and beloved friend (June 2009).

Authors

Carolee D. Francis, Doug Coulson, Bonnie Kalberer, Lemyra DeBruyn, William Freeman, and Janet Belcourt

JOURNAL OF HDRP

Journal of Health Disparities Research and Practice
Volume 3, Number 3, Spring 2010, pp. 91 – 105

The Significance of a K-12 Diabetes-Based Science Education Program for Tribal Populations: Evaluating Cognitive Learning, Cultural Context, and Attitudinal Components

Carolee Dodge Francis, University of Nevada, Las Vegas
Doug Coulson, PS International
Bonnie Kalberer, National Institutes of Health
Lemyra DeBruyn, Centers for Disease Control and Prevention
William Freeman, Northwest Indian College
Janet Belcourt, Stone Child College

Abstract

Preventing and reducing the onset of type 2 diabetes among American Indian/Alaska Native youth requires ground-breaking strategies to affect knowledge, attitudes, and cognitive decision-making skills. In an unparalleled endeavor to address the growing epidemic of type 2 diabetes in tribal communities, a K-12 Diabetes Education in Tribal Schools (DETS) curriculum was created by eight tribal colleges and three federal agencies. This article highlights the results of the implementation phase, the final evaluation step in acquiring and measuring student knowledge and attitude gains through pre-post standardized assessment.

Key Words: American Indian/Alaska Native, type 2 diabetes, youth, education, culture, K-12 curriculum, tribal schools

INTRODUCTION

The Diabetes-Based Science Education for Tribal Schools (DETS) curriculum focuses on K-12 students in tribal schools or schools with a high percentage of American Indian/Alaska Native (AI/AN) students. The founding mantra of the curriculum is Health Is Life in Balance. In recognizing and honoring cultural diversity among AI/AN people, the framing and relationship of place and balance is deeply rooted within connectedness of self, family, community and all that Mother Earth nurtures. Thus, the students gain knowledge of health and disease using Circle of Balance, a culturally based model intertwined throughout the curriculum. The curriculum is designed to meet the National Science Education Standards, which provide criteria to judge progress toward a national vision of

learning and a teaching system that promotes excellence (National Science Education Standards, 1996). In particular, the DETS curriculum focuses on learning science by doing science (Krajcik, McNeill, & Reiser, 2007). The DETS curriculum framework is built on excellence and equity in science education portrayed through culturally relevant contexts.

The cultural context for the science education components in the DETS curriculum reflects the disparate type 2 diabetes burden that AI/ANs bear (Centers for Disease Control and Prevention [CDC], 2003; Valway, Freeman, Kaufman, Welty, Helgerson & Gohdes, 1993). This context is particularly critical given the disproportionate burden of type 2 diabetes among young people in AI/AN populations compared with other populations (Dabelea, D., Hanson, R.L., Bennett, P.H., Roumain, J., Knowler, W.C., & Pettitt, D.J. 1998). Furthermore, from 1994 to 2004, the age-adjusted prevalence of diagnosed diabetes more than doubled among AI/ANs aged 35 years or younger who use Indian Health Service (IHS) health care services (CDC, 2006). Effective diabetes prevention programs targeting AI/AN youth are a compelling priority in education and public health because AI/ANs develop type 2 diabetes at younger ages (Roberts, 2009), experience more years of disease burden, and bear a high probability of developing diabetes-related complications (Harris, 1995).

The DETS curriculum incorporates intensive treatment of science-learning goals and innovative hands-on, culturally-based pedagogical approaches that enhance the meaning of the science content (Krajcik, et al., 2007). This is accomplished through a variety of venues that support Native culture as construct throughout the curriculum. For example, the link between the school classroom and the tribal community is constantly reinforced. By incorporating the respective tribal community world view and values that students bring into the classroom, the DETS curriculum purposefully encourages a restructuring of the relationship between classroom and community cultures, directing the learning towards a new set of goals for both teacher and student (Enyedy & Goldberg, 2004). This close alignment of the curriculum with tribal community values provides an effective and natural channel for taking type 2 diabetes preventive measures from the classroom into the community.

Here, we present preliminary findings from the phased implementation testing of the DETS curriculum. These results are based on evaluation of the process that examined student attainment of key scientific ideas and student attitude towards science. Teacher attitude and reaction to implementation as well as cultural context of an inquiry-based curriculum are also explored. Our intention is to present the merits of an inquiry-based, culturally responsive science curriculum that addresses a life threatening chronic disease.

Brief Program Description

In 2001, the congressionally authorized Diabetes Mellitus Coordinating Committee, chaired by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), part of the National Institutes of Health (NIH), hosted a meeting with the Indian Health Service Division of Diabetes Treatment and Prevention (IHS/DDTP) and the Tribal Leaders Diabetes Committee (TLDC) to address the seriousness of type 2 diabetes in AI/AN communities. At the meeting, NIDDK accepted the TLDC's challenge to lead the effort to help prevent type 2 diabetes in AI/AN youth by developing a curriculum that would teach the science of diabetes in tribal schools. What followed was a unique, cooperative effort that included three federal agencies: NIH, represented by NIDDK and the Office of Science Education (OSE), CDC's Native Diabetes Wellness Program, IHS/DDTP; eight Tribal Colleges and Universities (TCUs), and seven Sister Sites. The eight TCUs include: Cankdeska Cikana Community College (CCCC), North Dakota; Fort Peck Community College (FPCC), Montana; Haskell Indian Nations University, Kansas; Keweenaw Bay Ojibwa Community College (KBOCC), Michigan; Leech Lake Community College, Minnesota; Northwest Indian College (NWIC), Washington; Southwestern Indian Polytechnic Institute (SIPI), New Mexico; and Stone Child College, Montana. Sister sites were

additional tribal communities from across the nation not directly affiliated with the eight Tribal Colleges. These sites were recruited to broaden Native cultural diversity and expand the breadth of evaluation beyond the original eight TCUs.

The DETS curriculum focuses on three primary goals:

1. Increase the understanding of health, diabetes, and maintaining life in balance among AI/AN students (Teach about diabetes);
2. Increase AI/AN students' understanding and application of scientific and community knowledge (Value and use of scientific and traditional knowledge);
3. Increase interest in science and health professions among AI/AN students (Encourage science and health careers).

The curriculum is to be disseminated to tribal schools and public schools with a substantial number of AI/AN students. The intention is that the curriculum will be adopted by school systems to advance the three DETS goals nationwide.

Design

The DETS curriculum is in step with the adaptation of small-scale, relatively focused curricular projects that are directed to a specific context (Squire, MaKinster, Barnett, Luehmann & Barab, 2003). However, the DETS curriculum moves beyond a small-scale project to encompass a national AI/AN audience. The evaluation study examined the impact of the DETS K-12 curriculum that was specifically designed for easy implementation by teachers in a way that strongly reflects AI/AN cultures (Chino & DeBruyn, 2006; Chino, Dodge-Francis, DeBruyn, Short, & Satterfield, 2007; Satterfield, Eagle Shield, Buckley, & Taken Alive, 2007).

Settings and Context

The data presented here are based on the implementation of the DETS curriculum by the eight TCUs and the Sister Sites. We examined the way teachers utilized the curriculum in their respective classrooms as well as how students responded to the curriculum across a broad geographical and cultural spectrum. Data collection took place in Alaska, California, Florida, Kansas, Michigan, Minnesota, Montana, New Mexico, New York, North Dakota, Oregon, South Dakota, Washington, and Wyoming during the fall 2007 and winter 2008 school semesters. Teachers were primarily non-native and female.

The 2008 report on the Status and Trends in the Education of American Indians and Alaska Natives revealed that approximately one-third of AI/AN students attend schools in rural areas, compared with 15% white, 5% Black, 3% Hispanic, and 2% Asian/Pacific Islander students (DeVoe, Darling-Churchill, & Synder, 2008). The school settings testing the DETS curriculum nationwide had similar demographic characteristics. They were small, rural, tribal or public schools with a 50%-100% AI/AN student body. Schools were typically situated on or in close proximity to reservations. A number of settings included rural public schools with approximately a 25% AI/AN student body.

The research group, Schneider, Krajcik, Marx, and Soloway (2002), emphasizes the importance of "connectivity" to support student learning in science through inquiry. The DETS evaluation study was designed to examine the results of the national implementation of the inquiry-based DETS K-12 curriculum relative to academic impact, attitude, ease-of-use, and the integration of AI/AN content. Particular attention was given to the curriculum's cultural component and its adaptability. By combining science inquiry-based pedagogy with intrinsic AI/AN values, students were encouraged to develop inquisitive attitudes towards knowledge and experience based upon their own diverse cultures (Shor, 1992).

Data Collection Techniques

The DETS evaluation study incorporated several important design features. First, a national sample was developed based on the geographic locations of the participating TCUs and strategically chosen geographic representation of the Sister Sites. Second, specific grade level units were tested rather than all of the K-12 grades. Teachers taught units of DETS curriculum and conducted the assessments at the unit level. Third, to measure knowledge and attitude gains, pre-post standardized assessments were used in all participating classrooms. Finally, teachers received contracts with specific data administration requirements relative to curriculum implementation and assessment. These four design features maximized the standardization of implementation, assessment, and data collection.

The national sample guidelines set specific goals for the participating TCUs and Sister Sites that evenly distributed grades and levels (i.e., elementary, middle, high school) across the participating groups. The TCUs and Sister Site coordinator recruited classrooms at each participating grade level. Because not all grades were selected, the research design remained practical and focused. The grades that participated were: 3 and 4; 7 and 8; and 10 and 11. This strategy provided data at three school levels: elementary, middle, and high school. Finally, because of the amount of curriculum material written for grades 3 and 4, these grades were divided into two content levels: Units 1 and 2; Units 3 and 4. For the two higher grade levels, the DETS curriculum was divided into science and social studies (middle school), and science and health (high school). The number of classes (estimated at 15 students each) to be recruited was based on achieving an 80% power level for detecting a medium effect. Table 1 summarizes the national sampling plan.

Table 1. DETS Sampling Plan

TCUs	K-4 Grades 3-4 Units 1 & 2	K-4 Grades 3-4 Units 3 & 4	5-8 Grades 7-8 Science	5-8 Grades 7-8 Social Studies	9-12 Grades 10-11 Science	9-12 Grades 10-11 Health
Haskell	1 class	1 class	1 class		1 class	2 classes
KBOCC	1 class	1 class	1 class	1 class	1 class	1 class
Leech Lake	1 class		2 classes	2 classes		1 class
CCCC		1 class	1 class		2 classes	2 classes
FPCC	1 class	1 class		2 classes	2 classes	
Stone Child		1 class	2 classes	2 classes	1 class	
SIPI	1 class		2 classes	2 classes		1 class
NWIC		1 class	1 class		2 class	2 classes
TOTALS	5 classes	6 classes	10 classes	9 classes	9 classes	9 classes
Sister Sites	At least 1 class	At least 1 class	At least 1 class	At least 1 class	At least 1 class	At least 1 class

DETS Sampling Plan

Standardized assessments were developed for all six curriculum content areas being tested. Assessment focused on student academic achievement and attitude as well as teacher experiences with the curriculum. To stay within practical class schedule limitations, the tests (i.e., achievement and attitude) were designed to take 50 minutes or less (about one short class period). We anticipated that about 12 multiple choice and one or two short answer items for achievement and 10 attitude items would meet this criterion. For both achievement and attitude, a pre-post test strategy was implemented. Data on teacher experiences with the curriculum were collected after the DETS units were taught.

For achievement, the curriculum writing teams developed a pool of preliminary items that are associated with each of the six content areas listed in Table 2. These items were submitted to members of the DETS evaluation team that consisted of content experts and an assessment person composed of Native and non-Native professionals. The evaluation team finalized the standardized achievement test consisting of about 14 items (i.e., 12 multiple choice and two short answer questions) for each of the six content areas.

For attitude, the evaluation team selected ten items from the 50 item Test of Science-Related Attitude (TOSRA). The reading level of the TOSRA items was simplified for the third and fourth graders. A full Likert scale used in the two upper grade bands was simplified to include "agree"; "not sure"; and "disagree" for the 3-4 grade level.

A web survey measured teachers' ratings on ease-of-use, level-of-difficulty for students, comparability to similar curricula, AI/AN cultural content, and national science education standards. Findings from the web survey are summarized in the Results section.

Diabetes messages from the Eagle Books, developed by CDC's Native Diabetes Wellness Program and partners, were incorporated into the DETS K-4 unit lessons. The books are used to enhance the lessons relating to diabetes and community, and provide an illustrated story about an eagle and an American Indian boy and his friends. Sets of Eagle Books accompany DETS lesson materials for grades K-2 and 3-4, respectively.

Eagle Books messages were also tested. The third and fourth graders responded to eight yes/no questions on the Eagle Books. Four of the eight Eagle Book questions were adapted from the "Me and My Reading" scale used by the International Reading Association.

The combined application of the national sampling plan with these three assessment areas (i.e., student achievement, attitude, and teacher experience) provided a detailed look at the impact of the DETS curriculum relative to the three goals of the DETS program.

RESULTS

Data describing the number of classes, teachers and students participating in the DETS evaluation study appear below. We outline the findings relative to student achievement, attitude, career data, and teacher experience with the DETS curriculum in relation to the three grade levels: elementary school (ES) grades 3 and 4; middle school (MS) grades 7 and 8; high school (HS) grades 10 and 11.

Throughout the Results and Discussion sections, we examine the findings in terms of the six content areas within the three grade levels. The results are related to the three DETS goals in the Discussion Section. Table 2 summarizes these six (A through F) content areas, which are referred by their letter name. For example, content area E refers to high school science.

Table 2. Six Content Areas of DETS Curriculum

Content Area	Letter Designation
ES: Grades 3-4, Units 1 and 2	Area A
ES: Grades 3-4, Units 3 and 4	Area B
MS: Grades 7-8, Science	Area C
MS: Grades 7-8, Social Studies	Area D
HS: Grades 10-11, Science	Area E
HS: Grades 10-11, Health	Area F

Six Content Areas of DETS Curriculum

Overall, twice as many classes participated than were identified in the original sampling plan, resulting in a sample size of 1,519 students (original projection was 810 students), 63 teachers and 102 classes (original goal was 54 classes). Students were evenly distributed across the eight TCUs and seven Sister Sites. Table 3 below summarizes the number of students and classes that participated in this evaluation of the DETS curriculum.

Table 3. Number of Students and Classes per Six Content Areas of DETS Curriculum

Content Area	Students	Classes
ES: Grades 3-4, Units 1 and 2 (Area A)	233	15
ES: Grades 3-4, Units 3 and 4 (Area B)	153	10
MS: Grades 7-8, Science (Area C)	468	29
MS: Grades 7-8, Social Studies (Area D)	425	29
HS: Grades 10-11, Science (Area E)	94	7
HS: Grades 10-11, Health (Area F)	146	12

Results: Elementary, Middle, and High School Grades

Achievement and Attitude Pre and Post Means for Content Areas A through F

Four student areas of the elementary school results were examined: 1) achievement; 2) overall attitude; 3) overall attitude toward Eagle Books; and 4) student career data. Teacher attitude relative to ease-of-use, similarity to other curricula, Eagle Books and strength of Native American content was also examined. With the exception of the Eagle Books (only available at the elementary school level and presented below), these student and teacher variables were examined for the middle school grades and the high school grades.

For content Area A (grades 3 and 4; DETS units 1 and 2) data were received from 233 students across 15 teachers from 13 schools. For content Area B (grades 3 and 4; DETS units 3 and 4) data were received from 153 students across 10 teachers from 10 schools. The two Area A units covered Health is Life in Balance (five lessons) and Being Smart About Being Healthy (four lessons). The two Area B units covered Exploring Diabetes (six lessons) and Harvesting Our Mother Earth (five lessons).

An important factor for evaluating the DETS curriculum was whether or how the materials made their purpose explicit and meaningful to the students relative to students' preexisting knowledge, both conceptual and cultural (Kesidou & Roseman, 2002). For content Area C (grades 7 and 8 DETS science unit), data were received from 468 students across 13 teachers from 12 schools. For content Area D (grades 7 and 8 DETS social studies unit), data were received from 425 students across 10 teachers from 10 schools. The Area C science unit covered A Balancing Act: Preventing Diabetes (five lessons). The Area D social studies unit covered Life in Balance (four lessons).

For content Area E (grades 10 and 11 DETS science unit), data were received from 94 students across 6 teachers from 6 schools. For content Area F (grades 10 and 11 DETS health unit), data were received from 146 students across 9 teachers from 9 schools. The Area E science unit covered Understanding Homeostasis through Diabetes (seven lessons). The Area F health unit covered Diabetes and American Indian/Alaska Native Health (six lessons).

Strong knowledge gain patterns were found across grade levels for school content areas. For contents Areas A through F, student achievement was statistically significant from pre- to post testing, whereas student attitude showed no change. Table 4 below provides the means and standard deviations, and Figures 1-3 illustrate the achievement gains for the two elementary level content areas.

Independent samples t-tests were used to compare pre and post test achievement and attitude scores, where scores were independent responses at the student level, regardless of school. Paired samples t-tests were not used because it was not possible to link the pre and post scores. Without the correlation factor in the denominator of the t ratio, the independent samples t-tests are more conservative (i.e., more difficult to reject the null hypothesis).

Table 4. Achievement and Attitude Pre and Post Means for Areas A through F With Achievement 95% Confidence Intervals (CI) on Mean Gain

	Achievement			Attitude	
	Pre Mean (sd)	Post	95% CI	Pre	Post
Area A	7.6 (2.4) N = 212	10.5 (2.6) *	2.6 to 3.3	2.5 (.31) N = 213	2.5 (.34)
Area B	7.8 (2.5) N = 145	11.1 (2.4) *	2.8 to 3.7	2.5 (.31) N = 147	2.5 (.35)
Area C (Science)	4.7 (2.2) N = 400	6.7 (2.6) *	1.4 to 2	2.9 (.72) N = 402	2.9 (.76)
Area D (Social Studies)	8 (3.1) N = 339	9.3 (3.6) *	.5 to 1.3	3.0 (.68) N = 358	3.0 (.73)
Area E (Science)	5.3 (2.3) N = 86	9.2 (3.2) *	3.3 to 4.8	2.6 (.68) N = 90	2.7 (.77)
Area F (Health)	7.4 (2.6) N = 136	8.4 (3.0) *	.7 to 1.6	3.0 (.66) N = 136	3.0 (.71)
* $p < .001$					

Figure 1 - Grades 3 & 4
Pre-Post Achievement Gains

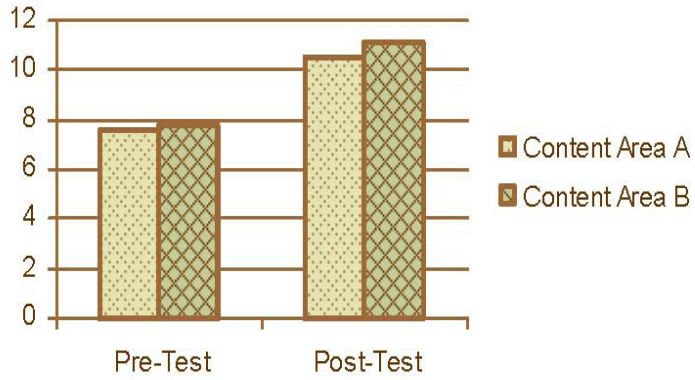


Figure 2 - Grades 7 & 8
Pre-Post Achievement Gains

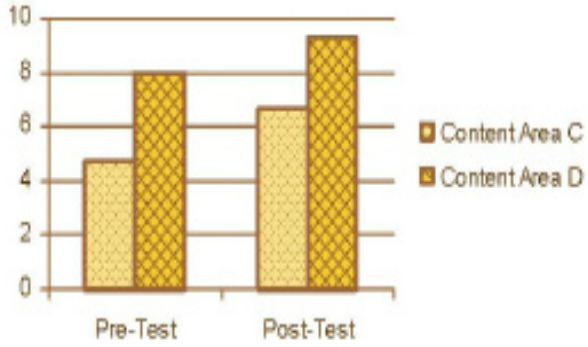
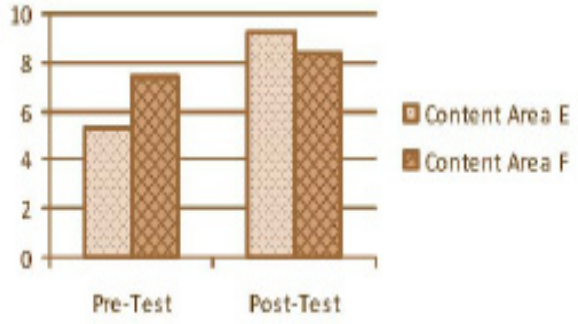


Figure 3 - Grades 10 & 11
Pre-Post Achievement Gains



Pre-Post Career Percentages for Students for Content Areas A-F

On the pre- and post surveys, students were asked what they would like to be or do when they grew up. Responses were rated as: 1) undecided from pre-to-post; 2) non-science career from pre-to-post; or 3) science career from pre-to-post. These responses were analyzed by asking: given a change from pre-to-post, what was the percentage that changed from a non-science career to a science career? Science was defined broadly to include medicine (doctors and nurses), lab technicians and researchers.

Table 5 summarizes pre-post career percentages for content areas A through F. The column 4 percentages are conditional values. For example, the 71% indicates that 71% of 24 elementary students who changed careers from pre-to-post changed to science in the post survey. The 24 elementary students who indicated a change from pre-to-post constituted about 12% of the elementary school students (Areas A and B). Similarly, for middle school students (Areas C and D),

about 12% indicated a change from pre-to-post. Finally, for high school students (Areas E and F) about 16% indicated a change from pre-to-post. Thus the numbers in Table 5 are conditional on these subsets of students (i.e., the 12%; 12% and 16%) who indicated a change from pre-to-post. These three subsets of students were analyzed in Table 12 by asking the conditional question: what was the percentage that changed from non-science to science, given (the conditional) that they indicated some kind of pre-to-post change. Also note that the 12%; 12%; 16% were calculated from the Area Ns (areas A through F) and thus one cannot simply average the percentages in column 4 of Table 5 to get these three percentages. Ns were used for these three percentages in order to reflect the proper weighting. These responses were analyzed by asking: given a change from pre-to-post, what was the percentage that changed from a non-science career to a science career? The conditional percentages in column 5 of Table 5 are exploratory analyses due to low N, and consequently no inferential statistical procedures such as confidence intervals were calculated for these data. Table 5 presents descriptive statistics only.

Table 5. Pre-Post Career Percentages for Elementary, Middle, and High School Students

	1: undecided pre to post	2. non-science in pre and in post	3. science in pre and in post	4. change from pre to post	5. given change, % into science
Area A (N = 191)	5%	55%	36%	4%	71% of col #4 (N = 24)
Area B (N = 142)	4%	65%	24%	7%	52% of col #4 (N = 17)
Area C (N = 349)	11%	53%	32%	12%	57% of col #4 (N = 28)
Area D (N = 301)	14%	57%	27%	2%	26% of col #4 (N = 23)
Area E (N = 82)	5%	39%	50%	6%	67% of col #4 (N = 9)
Area F (N = 119)	17%	44%	24%	15%	35% of col #4 (N = 26)

The perspective of teacher learning is essential in attaining substantial change in students utilizing inquiry teaching strategies and activities (Davis, 2003). We found it essential not only to observe the teachers but also to gain their input about the instruction and cultural context. Through this exploration of classroom practices, beliefs and knowledge, the support or limitation of future targeted professional development can be achieved (Roehrig, Kruse & Kern, 2007). Therefore, as noted previously, teacher attitude towards the DETS curriculum was further examined regarding ease-of-use, relative engagement compared to similar curricula, and strength of AI/AN content.

Table 6 summarizes these results. Teachers indicated there was an excellent alignment of the DETS curriculum with the national science education standards. Teachers felt that the DETS curriculum was easy-to-use and generally more engaging than similar curricula. The Native American content was generally rated as strong or very strong by teachers. Specifically, 87% of the elementary school teachers said that content Area A was well aligned with the national science education

standards; 90% of the teachers said that content Area B was well aligned with the standards. Further, 70% of the middle school teachers said that content Area C was well aligned with the national science education standards; 100% of the teachers said that content Area D was well aligned with the standards. Finally from their perspective, 100% of the high school teachers said that content Area F was well aligned with the national science education standards. Data were not available for content Area E.

Table 6. Teachers' Attitude toward Components of the DETS Curriculum

	Ease of use	More engaging than similar curricula	Strong Native American content
Area A (N=15)	100%	100%	100%
Area B (N=10)	90%	90%	100%
Area C (N=11)	91%	100%	100%
Area D (N= 9)	100%	89%	100%
Area E (N= 8)	89%	87%	75%
Area F (N= 9)	89%	67%	88%

Elementary Student and Teacher Perceptions of Eagle Books

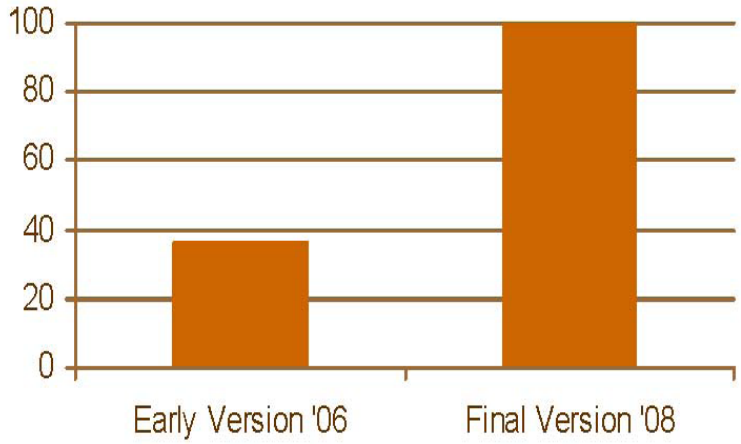
Both students and teachers rated the Eagle Books. From the students' perspective the Eagle Books were fun and liked. Table 7 summarizes the responses of students (Table 7 below). From the teachers' perspective, the Eagle Books supported lesson content, were liked by students, and were generally relevant to the DETS curriculum (Table 8 below).

Table 7. Students' Attitude towards the Eagle Books	**Area A (N=232)**	**Area B (N=153)**
I like the Eagle Books	92%	92%
Eagle Books were fun to read	92%	91%
I would like to own Eagle Books	82%	76%
Eagle Books make a nice gift	88%	88%

Table 8. Teachers' Attitude towards the Eagle Books	**Area A (N=15)**	**Area B (N=10)**
Liked by the students	100%	90%
Supported lesson content	100%	100%
Generally relevant	100%	100%

While this paper presents the results of the DETS implementation testing phase only, in an earlier pilot study version of the DETS curriculum in 2006, results indicated inconsistent knowledge gains across content areas. Consequently, the curriculum was revised and retested. Results from the implementation phase, as presented here, demonstrate consistent statistically significant knowledge gains across all content areas. If the previous study of the earlier version of the curriculum is considered as a baseline, the percentage of knowledge gains rose from 36% to 100%. Figure 4 illustrates this result, indicating that all of the pre-to-post knowledge gains were statistically significant.

Figure 4. Percent Pre-to-Post Knowledge Gains



DISCUSSION

The statistical pattern across all three grade levels (i.e., elementary; middle; high school) gives a picture of a strong curriculum in overall terms as well as relative to the DETS goals. Only the attitude measure was flat. The other indicators, however, increased after exposure to the DETS curriculum.

Attitude means were flat from pre to post across all three grade levels. There are several possible reasons: first, the attitude scale was based on items from the TOSRA. These items were general science attitude questions and not specific to the DETS curriculum. Second, attitude typically does not change over a short period of time. The DETS units took about two weeks to complete, potentially not enough time for a shift in attitude related to science in general rather than attitude related to the particular content of the DETS curriculum. Subsequent research should include specific diabetes attitude items related to the curriculum. Finally, future research will look at attitude change as students are exposed to the DETS curriculum across grade levels, hence, for longer periods of time.

Relative to the first goal (cultural aspects), content areas A, B, D and F provide strong evidence of knowledge gain. Content areas (A and B) at grade levels 3 and 4 emphasized health from an individual and community perspective. These individual and community aspects of the curriculum were partly based on the role of community and culture for improving health of individuals and families within communities. As Table 4 shows, there was statistically significant improvement from pre-test to post-test in content areas A and B (i.e., for all pairwise t-test comparisons $p < .001$).

Content area D focused on middle school social studies with a strong cultural basis, showing strong statistical gain in knowledge means (i.e., t-test comparison $p < .001$). Content area F focused on high school health. This content area linked the concept of health is life in balance to individual, community and cultural traditions of eating and exercise, and demonstrated statistically significant knowledge gains for the DETS high school health unit (i.e., t-test comparisons $p < .001$).

Concordant with significant knowledge gains in curriculum areas related to community and cultural content, teachers across the three grade levels rated the Native American content as strong or very strong. At the high school level, the percentages dropped from 100% to 75% and 88%, respectively. However, there were only 6 science and 9 health high school teachers; thus, this drop in percentage points only represented 3 or 4 teachers. This is not a significant number of teachers in a study that had 62 teachers across the three grade levels.

Strong AI/AN content with ease-of-use and teacher engagement ratings (see Tables 6, 7, and 8) indicate a curriculum whose content and format was very successful in communicating cultural content. In all four content areas that were based on community and cultural content, there were statistically significant knowledge gains.

Relative to the second goal (science and traditional knowledge), the test results demonstrated strong knowledge gains. Content areas C and E both focus on science content. Content area C focuses on middle school science, while content area E focuses on high school science. Table 5 demonstrates that both pairwise t-test comparisons were statistically significant ($p < .001$). This result held up even when sample size was substantially lower for area E (i.e., $n = 94$) relative to the other areas where sample size ranged from a low of 153 to a high of 468.

Relative to the third goal (interest in science careers), there is reasonable evidence that the curriculum had a positive impact. It is worth noting that overall students were not undecided when asked what they wanted to do or be when they grew up. As is clear from Tables 5, a very low percentage of students (range: 4% to 17%) stated that they were undecided when asked what they wanted to be or do when they grew up. The vast majority of the students appeared to have very definite statements about future careers. These future career interests ranged from actress to president; students exhibited a remarkable concreteness about career goals:

"I want to be a dentist like my mom."

"I want to be like my dad and go into construction."

Student career statements provided two additional findings. First, a substantial percentage of students indicated interest in science related careers on both their pre-test and post-test answers, where science is broadly interpreted as working in medicine, dentistry, nursing, labs and research. Specifically, a quarter to half of the students indicated on both the pre-test and post-test that they would pursue a career that was related to science. Second, among those students that changed career choices from pre-test to post-test, there was a very high percentage where the change was into a science related career from a non-science related career. Specifically, between 26% and 71% of the students who changed their career choices changed to a science related career (see Table 5). For example, one student changed from wanting to be a singer to wanting to be a dentist. These student expressions represent positive career changes. While there are too many factors to attribute these changes solely to the DETS curriculum, these results reflect positively on the third DETS goal and warrants further investigation

Table 9 summarizes the findings discussed in the Results section that supports each of the three DETS goals.

Table 9. Data and DETS Goals

DETS Goals	Supporting Data
1. Maintaining life in balance (cultural)	1. Statistically significant knowledge gains in content areas A, B, D, and F 2. Teacher perception of strong Native American content
2. Understanding scientific and community knowledge (science)	1. Statistically significant knowledge gains in content areas C and E
3. Showing an interest in science and health professions (careers)	1. Pre-post shifts toward science careers 2. Anecdotal student comments

Overall, the findings described in this evaluation study show that the DETS curriculum had an effective impact relative to its three goals. Teachers throughout the six content areas rated the Native American content of the DETS curriculum as strong or very strong. Across all six content areas of the three grade levels (i.e., elementary, middle, high) students consistently showed statistically significant knowledge gains.

Where there was a change in career choice from pre-to-post, a substantial percentage changed from non-science to science. This last finding is based on small sample size conditional percentages and would need to be further verified with additional research. These findings show that the DETS curriculum strongly support the three goals of the DETS curriculum project.

We realize that methods to determine and measure attitudes within a shortened framework have limitations and that long term behavior change is an unknown. Success of the DETS curriculum goals and objectives through the enjoyment of the participants is only one step in defining a statistical significance pattern among participants in this early phase of implementation (Laursen, Liston, Thiry, & Graf, 2007).

CONCLUSION

In this paper, we described the evaluation study results of the collaboratively developed Diabetes Education in Tribal Schools curriculum. The DETS curriculum, available from the Indian Health Service's Division of Diabetes Treatment and Prevention, presents diabetes science framed in the culturally relevant contexts of American Indians and Alaska Natives. The curriculum was carefully crafted to meet national science education standards, and can serve as a supplement for science, social science, and health education lessons across all grade levels. The earlier grade levels can also be adapted for pre-K education.

The DETS steering committee, representing eight TCUs within their respective tribal communities, the Sister Site communities, and three federal agencies, never lost sight of why this curriculum was asked for by the Tribal Leaders Diabetes Committee in 2001. While diabetes is a devastating disease and impacts AI/AN communities disparately, much can be done to prevent diabetes and its complications. This curriculum was developed with a deep sense of hope that the messages and lessons of the DETS curriculum, in conjunction with other national and community education and public health efforts, can reverse and eventually eliminate the rising trends of type 2 diabetes and its complications for AI/AN people.

REFERENCES

Centers for Disease Control and Prevention. (2003). Diabetes prevalence among American Indians and Alaska Natives and the overall population --- United States, 1994—2002. Morbidity and Mortality Weekly Report, 52, 702-704.

Centers for Disease Control and Prevention. (2006). Diagnosed diabetes among American Indians and Alaska Natives Aged <35 Years --- United States, 1994—2004. Morbidity and Mortality Weekly Report, 55, 1201-1203.

Chino, M., & DeBruyn, L. (2006). Building true capacity: Indigenous models for indigenous communities. American Journal of Public Health, 96, No. 3, 9-12.

Chino, M., Dodge-Francis, C., DeBruyn, L., Short, L., & Satterfield, D. (2007). The convergence of science and culture: Developing a framework for diabetes education in tribal communities. Journal of Health Disparities Research and Practice, 1, No.3, 75-87.

Dabelea, D., Hanson, R.L., Bennett, P.H., Roumain, J., Knowler, W.C., & Pettitt, D.J. (1998). Increasing prevalence of type II diabetes in American Indian children. Diabetologia, 41, 904-910.

Davis, Kathleen, S. (2003). "Change is Hard": What science teachers are telling us about reform and teacher learning of innovative practices. Science Education, 87, No. 1, 3-30.

DeVoe, J., Darling-Churchill, K., & Snyder, T.(2008). Status and trends in the education of American Indians and Alaska Natives. U.S. Department of Education, Institutes of Education Statistics.

Enyedy, N., & Goldberg, J. (2004).Inquiry in interaction: How local adaptations of curricula shape classroom communities. Journal of Research in Science Teaching, 41, 905-935.

Harris, M.I. (1995). Chapter 1: Summary. In: Harris, M.I., Cowie, C.C., Stern, M.P., Boyko, E.J., Reiber, G.E., Bennett, P.H., (Eds.), Diabetes in America. 1-13.

Kesidou, S. & Roseman, J. (2002). How well do middle school science programs measure up? Findings from project 2061's curriculum review. Journal of Research in Science Teaching, 39, 522-549.

Krajcik, J., McNeill, K. L., & Reiser, B. (2007). Learning-goals–driven design model: Developing curriculum materials that align with national standards and incorporate project-based pedagogy. Wiley InterScience (www.interscience.wiley.com).

Laursen, S., Liston, C., Thiry, H., & Graf, J. (2007). What good is a scientist in the classroom? Participant outcomes and program design features for a short-duration science outreach intervention in K-12 classrooms. Life Sciences Education, 6, 49-64.

National Science Education Standards. (1996). National Research Council. Washington D.C. National Academy Press.

Roberts, H., Jiles, R., Mokdad, A., Beckles, G., Rios-Burrows, N. (2009) The widening gap of diabetes between American Indian/Alaska Native young adults and Non-Hispanic young adults. Ethnicity & Disease, 19, 2009

Roehrig, Gillian, H., Kruse, Rebecca, A., Kern, Ann. (2007). Teacher and school characteristics and their influence on curriculum implementation. Journal of Research in Science Education, 44, 883-907.

Satterfield, D., Eagle Shield, J., Buckley, J., & Taken Alive, S. (2007). So that the people may live (hecel lena oyate ki nipi kte): Lakota and Dakota elder women as reservoirs of life and keepers of knowledge about health protection and diabetes prevention. Journal of Health Disparities Research and Practice, 1, No.2, 1-28.

Schneider, R.M., Krajcik, J. Marx, R. W. & Soloway, E. (2002). Performance of students in project-based science classrooms on a national measure of science achievement. Journal of Research in Science Teaching, 39, 410-422.

Shor, I., (1992). Empowering education: Critical teaching for social change. Chicago: The University of Chicago Press.

Squire, K. D., MaKinster, J.G., Barnett, M., Luehmann, & A.L., Barab, S. L., (2003). Designed curriculum and local culture: Acknowledging the primacy of classroom culture. Science Education, 87, 468-489.

Valway, S., Freeman, W., Kaufman, S., Welty, T., Helgerson, S.D., & Gohdes, D. (1993). Prevalence of diagnosed diabetes among American Indians and Alaska Natives, 1987. Estimates from a national outpatient database. Diabetes Care, 16, 271-276.

ACKNOWLEDGEMENT

In memory of Janet Belcourt, our dedicated leader and beloved friend (June 2009).

DETS CURRICULUM & PUBLICATION GROUP MEMBERS

Joni Ackerman, Fort Peck Community College, Montana, Larry Agodoa, NIH National Institute of Diabetes and Digestive and Kidney Diseases, Maryland, Lynn Aho, Keweenaw Bay Ojibwa Community

College, Michigan, Janet Belcourt, Stone Child College, Montana, Shelly Bointy, Haskell Indian Nations University, Kansas, Roger Bybee, Formerly with Biological Sciences Curriculum Study, Colorado, Michelle Chino, University of Nevada Las Vegas, Las Vegas, Nevada, Doug Coulson, PS International, Maryland, Jennifer Curry, NIH National Institute of Diabetes and Digestive and Kidney Diseases, Maryland, Lemyra DeBruyn, CDC Native Diabetes Wellness Program, New Mexico, Carolee Dodge Francis, University of Nevada Las Vegas, Nevada, Ida Downwind, Formerly with Leech Lake Tribal College, Minnesota, Thalia Esser, Minot State University, North Dakota, Barbara Eversvik, Warwick High School, North Dakota, William L. Freeman, Northwest Indian College, Washington, Sanford Garfield, NIH National Institute for Diabetes and Digestive and Kidney Diseases, Maryland, Timur Gaston, Northwest Indian College, Washington, Lars Helgeson, University of North Dakota, North Dakota, Marilyn Hetzel, Utah State University, Utah, Mary Hindelang, Keweenaw Bay Ojibwa Community College, Michigan, Bonnie Kalberer, NIH Office of Science Education, Maryland, Cynthia Lindquist Mala, Candeska Cikana Community College, North Dakota, Carol Maller, Southwestern Indian Polytechnic Institute, New Mexico, Kenan Metzger, Ball State University, Indiana, Dolly Narajo Neikrug, Santa Clara Pueblo, New Mexico, Malinda Pekarcik, Santa Clara Pueblo, New Mexico, Stephanie Pinnow, Keweenaw Bay Ojibwa Community College, Michigan, Jerry Phillips, Formerly with Biological Sciences Curriculum Study, Colorado, Heather Rozler, Haskell Indian Nations University, Kansas, Dawn Satterfield, CDC Native Diabetes Wellness Program, Georgia, Barbara Schulz, Northwest Indian College, Washington, Suzanne Turnbull, Fort Peck Community College, Kansas, Ann Westbrook, Biological Sciences Curriculum Study, Colorado, Juanita Wiley, Leech Lake Tribal School, Minnesota, Dan Willert, Four Winds High School, North Dakota

The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official positions of the Centers for Disease Control and Prevention.

Carolee Dodge Francis, Ed.D., Assistant Professor
University of Nevada, Las Vegas, Las Vegas, NV 89154

Doug Coulson, Ph.D. , Consultant,
PS International, Arnold, MD 21012

Bonnie Kalberer, Sr. Program Officer,
Office of Science Education, NIH, Rockville, MD 20852

Lemyra DeBruyn, Ph.D., Senior Scientist,
Native Diabetes Wellness Program, Division of Diabetes Translation, CDC, Albuquerque, New Mexico 87110

William Freeman, M.D., Principal Investigator,
Northwest Indian College, Bellingham, WA 98226

Janet Belcourt, MPH, Principal Investigator,
Stone Child College, Box Elder Montana 59521