Teaching Science to Those Who Have No Word for It

The Question

This research project aims to answer the question: How can science education be improved for Alaska Native students? I will be working with The Imaginarium Science Discovery Center in Anchorage, Alaska to investigate this question through an evaluation of the newly-developed Yup'ik science curriculum. The mission of the Imaginarium is "to stimulate interest in and understanding of science and technology through exciting, inquiry-based, hands-on, minds-on exhibits and programs." Currently, The Imaginarium is piloting a Yup'ik science program to be delivered in five rural schools. *Yuungnaqpiallerput: The Way We Genuinely Live* science curriculum, funded by the National Science Foundation (NSF), aims to improve science understanding through the use of culturally relevant concepts and tools. With traditional uses of driftwood as the medium, the K-12 classes integrate Yup'ik language and ways of knowing with western science concepts. This project will evaluate the effectiveness of the curriculum delivered in order to improve the way that science concepts are taught.

The Problem

In 2001, not one student from a rural school district, where primarily Alaska Native students reside, passed the high school exit exam (Jones & Ongtooguk, 2002). Alaska Native students score lower than Caucasian students do on the National Assessment of Educational Progress (NAEP) science exams; Alaska Native 12th graders 56% scored "below basic" compared to Caucasian 12th graders with a 38% score "below basic" (Freeman & Fox, 2005). These startling statistics are the result of a deeper problem. Differences in learning styles, vocabularies, and ways of gathering and preserving information between western science and Alaska Native culture have been identified as problems that can be addressed in order to improve science understanding.

Western science curriculum is based on a learning style that is inconsistent with Alaska Native culture (Swisher & Dehyle, 1987). Western science and traditional ways of knowing utilize different vocabularies. Ann Fienup-Riordan, author of *Yuungnaqpiallerput: The Way We Genuinely Live* on which the curriculum is based, has discussed this problem with elders. Elders emphasize that the Yup'ik language does not have a word for "science" and that what western

scholars now separate into “religion” and “science” was not differentiated in the past. Everyday tasks such as hunting and healing were both scientific and spiritual. In addition, western science preserves information through standardized written record. A strong oral tradition is valued in Alaska Native culture. Important observations are contained in story, dance, and ceremony; it is the elders, living in the community, who hold on to it and pass it on to younger generations (Fienup-Riordan, 2007). Western science is taught in a formal setting by knowledge experts.

A gap is created that results in Alaska Native students not understanding or appreciating western science concepts. The many differences in learning styles, vocabulary, and methods of gathering information from the world around them have created a population of students who are not prepared for the world- urban, rural or international.

A Review of the Existing Literature

Educators and researchers alike have investigated the many roots of the problem: non-indigenous teachers unaware of cultural conduct, learning styles not addressed in western science curriculum, and the curriculum itself (Swisher & Dehyle, 1987; Miller, 1997; Price, 2003; Kawagley, 1999; and Zwick & Miller, 1996). In schools across the country, culturally responsive curriculum has been instituted with much success (Reyhner, 2001; Miller, 1997; Hilberg & Tharp, 2002; Lowaima & McCarty, 2002). Alaska has begun to address this problem by creating new content standards that focus on culturally responsive pedagogy and curriculum to address the issue (Alaska Native Knowledge Network, 1998).

Teaching in a rural community using a standard curriculum is not a simple task, especially when teachers come from a culture other than that of their students. Teachers confront many obstacles that impede the transmission of valuable knowledge. Personal narratives by educators who have taught in Alaska Native Yup’ik villages describe the difficulties teachers face. Teacher Kimberly Price quickly learned that simple lectures followed up with questions were not effective because Yup’ik children were taught to listen and not ask questions (2003). Using traditional stories and bringing elders into the classroom proved more effective (Price, 2003). Price (2003), Miller (1997), and Kawagley (1999), all educators, suggest intertwining traditional and western science for the benefit of the Yup’ik community and its students.

Cultural differences in learning styles are one of the issues that teachers face according to Brown (2007), Pewewardy (2002), Miller (1997), Richards, Brown, & Forde (2007), Zwick & Miller (1996), Hilberg & Tharp (2002), and Bowman (2003). In western science curriculum, the approach is much more competitive and impulsive; students work alone and are rewarded for answering questions first (Pewewardy, 2002). According to research by Pewewardy, Alaska Native students are "global processors"; instead of making a decision by simply looking at the problem, they tend to reflect on the environment surrounding the problem and how it affects their world (2002). Because of the traditional use of knowledge for subsistence and survival, Native students learn better using a holistic approach, hands-on and visual activities, and group projects (Swisher & Dehyle, 1987). Many researchers found the current system of education to be at odds with learning styles of indigenous students (Richards, Brown, & Forde, 2007; Pewewardy, 2002; Zwick & Miller, 1996; and Bowman, 2003).

The Community Responds

There is no doubt that there has been a call for educators to begin addressing cultural diversity in the classroom. Richards, Brown, and Forde (2007) state that culturally responsive pedagogy allows for greater student achievement through more individualized learning plans and extensive teacher training. Brown also notes the importance of preparing teachers to be culturally responsive (2007). This includes developing new curricula and knowing basic knowledge on the cultures of students (Brown, 2007).

The Alaska Native Knowledge Network (1998), Richards, Brown, & Forde (2007), and Fox (2000) all strongly recommended setting content standards for culturally responsive education. In this effort, the Assembly of Alaska Native Educators adopted Alaskan culturally responsive education standards in February of 1998 which included blending traditional ways of knowing with western curriculum (Alaska Native Knowledge Network, 1998). Fox says this regarding changes to standards: "The development of new standards and tests could be helpful to Indian education, especially in states where the content more closely reflects topics relevant to local students, including Indian students" (Fox, 2000).

The Imaginarium's Yup'ik science curriculum benefits from existing examples of culturally responsive programs and their success. Reyhner (2001), Miller (1997), Hilberg &

Tharp (2002), Lomawaima and McCarty (2002) all give examples of culturally relevant curricula that take on western science concepts using traditional methods of observation or indigenous activities. Miller writes about a class at the high school specifically called Yup'ik Studies where girls learn to make quilts and Eskimo dolls while learning Yup'ik language (1997). Hilberg and Tharp mention a sixth grade math class in New Mexico where some students formed student-led groups to complete tasks while others individually solved problems. The students in the groups scored better on achievement tests related to the tasks performed in comparison to the individual students (2002). Reyhner found that other studies are accumulating evidence in support of bilingual education to improve reading skills in both languages (2001). However, there is limited evidence-based research on the efficacy of these programs. This project examines the efficacy of the Imaginarium's Yup'ik science curriculum to improve the program and to provide recommendations about what does and does not work for future curriculum designers and teachers.

Methodology

In order to promote the understanding of science through the blending of traditional ways of knowing and western curriculum, the Imaginarium's Yup'ik Science program has been created to demonstrate science concepts by considering the uses of driftwood. Two Imaginarium educators will be sent to deliver programs to over 1,000 K-12 students living in Southwest Alaska. The classes cover subjects such as uses of driftwood, significance of driftwood masks, carving driftwood, and mixing traditional paints. Each class uses a traditional narrative, hands-on activities, and Yup'ik language. I will conduct an evaluation of this program. To do this, I will meet monthly with Imaginarium educators Alex Price, Renae Bookman, Michelle Hiatt, and Jacki Bond in order to identify strengths and weaknesses in the curriculum. I will accompany two educators to assist in delivery of the programs and evaluate the success of the curriculum in Togiak, Manokotak, Aleknagik, and New Stuyahok. This will take place in January 2008. These schools have never received any programs from the Imaginarium's Yup'ik science curriculum. Upon approval of the UAA IRB, I will also interview elders involved with the program as well as community leaders and I will design a simple instrument in the form of pre and post tests to assess understanding and appreciation of the science concept before and after the curriculum is delivered. I will evaluate the success of the program by measuring the changes in understanding

and appreciation of the science concept using the pre-and post-tests. Additional data will come from evaluation sessions with the teachers and the interviews with elders and community members.

Anticipated Results

I will produce a final paper analyzing the results of interviews with educators, elders and the pre and post tests. This paper, an annotated bibliography, a PowerPoint presentation, and a large poster will be the medium in which I communicate my findings to educators seeking to improve science education. I anticipate that my findings will assist The Imaginarium's Program Department in designing culturally responsive curricula and as they pursue other funding related to culturally responsive education.

I hypothesize that, while it is not in the scope of this study to examine changes in scores on standardized tests, students will achieve higher scores on the post-tests I designed after participating in the culturally responsive curriculum. I also expect that the results of interviews with native elders will reveal greater appreciation for and understanding of the relevance of western science to village life.

In the near future, The Imaginarium and other educational entities will pilot similar programs to continue toward a culturally responsive national curriculum. Other rural and urban schools will request the programs to be delivered to help Alaska Native students see the important connections between western science and traditional ways of knowing. In the long term, following the steps of Alaska, I hope to see more states establish culturally responsive content standards for curriculum.

Project Budget

Note: The curriculum itself was funded through a National Science Foundation (NSF) grant. Producing and administering pre- and post-tests, creating evaluations, and conducting interviews are not included in the original grant proposal and therefore, are not funded under the NSF grant. In addition, my travel as an investigator, copies of tests, interviews, and evaluations, and gifts for elders are not covered under the NSF grant.

a. Travel Expenses $790.00
   i.e. flights to and between villages
b. Copying and Printing $329.30
c. Community Relations Expenses $176.85
   i.e. gifts for elders
   Total Budget $1296.15

Travel Expenses

The estimate for travel is based on Peninsula Airways rates. They are the one company that can fly to all of the sites. A roundtrip flight for one passenger from Anchorage to Dillingham, the closest major airport to the other rural sites, is $296. A one-way flight for one passenger from Dillingham to Togiak is $99. A one-way flight for one passenger from Togiak to Manokotak is $60. A one-way flight for one passenger from Manokotak to New Stuyahok is $132. A one-way flight for one passenger from New Stuyahok to Aleknagik is $143. A one-way flight for one passenger from Aleknagik to Dillingham is $60. These are the posted rates for a January 2008 trip as of October 2007. Housing and meal costs are covered by the Imaginarium. Typically, Imaginarium staff members are housed in the school gymnasium.

Copying and Printing Expenses

Fed-Ex Kinko's charges $.10 per black and white copy. I will make 1,000 copies each of the pre- and post-tests, 100 copies of the evaluations, 40 copies of my report for community leaders to review, and three copies of interview questions for the community elders to review. I will produce a poster for presentation; because the Imaginarium has equipment to produce and laminate small posters I estimate the material cost for producing the poster to be $10. I will also need to copy 1,000 informed consent forms to provide to the parents of students. I will copy 50 information pages to provide to teachers to give background on the research project.

Community Relations Expenses

I will make three gift baskets to give to three native elders for sharing information. Each basket will cost no more than $50. I have added $8.95 for each basket to account for mailing expenses using a United States Postal Service Flat Rate box.

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Project Timeline

Late October 2007- Prepare pre- and post-tests for programs

November 2007- Prepare program evaluations and interview questions

November 2007- Seek IRB Approval for proposal

November 2007- Send copies of proposal to elders and community leaders in Togiak region

November 2007- Meeting with faculty advisor

November 2007 –Meeting with director of Imaginarium and educators

December 2007- Plan trip to Togiak region schools

December 2007- Meeting with faculty advisor

December 2007- Meeting with director of Imaginarium and educators

Late January 2008- Travel to Togiak region schools to evaluate programs

January 2008- Meeting with faculty advisor

January 2008- Meeting with director of Imaginarium and educators

February 2008- Finish compilation of data

February 2008- Meeting with faculty advisor

February 2008- Meeting with director of Imaginarium and educators

March 2008- Create PowerPoint presentation of research

March 2008- Meeting with faculty advisor

March 2008- Meeting with director of Imaginarium and educators

March 2008- Send findings to community leaders in Togiak region

Mid-April 2008- Presentation at the Undergraduate Research Symposium

May 31, 2008- Expenditure deadline

June 15, 2008- Final written report deadline