

Everyday Life Science and Engineering: Bridging the Gap Between Formal and Informal Learning among Native American Students in the Northwestern United States

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Abstract: This poster explores Native American student ideas regarding science and engineering and tries to understand how they bridge the formal and informal perceptions of these two disciplines. Students from a tribal community in the Northwest participated in a summer camp that focused on merging indigenous and non-indigenous knowledge systems about science and engineering. Using drawings, storytelling and interviews, the study discusses learning processes associated with youth who live in one Native American community as they develop an understanding of science and engineering phenomena.

Introduction

Even though there is overwhelming evidence that suggests that learning is a socio-cultural phenomenon, designing learning environments for Indigenous students is a challenging endeavor (Aikenhead, 1995, 1996; Smith, 1982, 1995; Snively, 1990, 1995; Wright, 1992). In order to create an optimal learning environment for Indigenous students, not only does the content have to be culturally relevant, but it also needs to be aligned with the learning processes of the students (Bang & Medin, 2010). As students move through formal (school) and informal (out of school) spaces, families, friends, teachers and communities become primary sources of knowledge, while local ways of knowing become the processes through which students realize the knowledge (Bell, et al, 2007).

This study examines Native American students (from one tribal community in the northwestern United States) perceptions of science and engineering as they move through formal and informal learning spaces and struggle with Eurocentric and indigenous epistemologies. The study is designed to find out how students connect science and engineering phenomena to their everyday life, so as to bridge the gap between the formal and informal learning spaces that they experience. The research questions that the study seeks to answer are as follows: 1. What perceptions do Native American middle school students from one tribal community in the northwestern United States have about science and engineering? 2. How do these students negotiate their perceptions and understandings of science and engineering as they move through different learning spaces? 3. How do the students understand science and engineering as a part of their everyday lives?

Theoretical Background

This research takes into consideration that theories in socio-cultural learning try to understand 'what people think' (Banks, 2007), while the collateral learning theory tries to understand 'how people think' (Solomon, Scott & Duveen, 1994). Socio-cultural learning theories emphasize that learning is contextual and is supported by various societal constructs (Barron, et al, 2009). Collateral learning, on the other hand, tries to explain how the students make sense of what they know (Aikenhead & Jegede, 1999). Jegede, 1995 proposes that there are four types in collateral learning processes – Parallel, Simultaneous, Dependent and Secured. Collateral learning theory tries to explain how indigenous students might store conflicting ideas (Eurocentric Scientific and indigenous) in their long-term memory. For example, parallel collateral learning is observed when indigenous students construct Eurocentric science concepts parallel to the indigenous concepts, with very little interference and interaction between the two. For optimal learning to happen it is important that both 'what students think' and 'how they think' are merged together (Bang, Medin & Atran, 2007). To this end, the research questions in this study are designed to understand what students think and how students think about science and engineering phenomena. The first research question is designed to understand 'what' do the students think about science and engineering phenomena, while the second and third research questions emphasize 'how' students negotiate their understanding of science and engineering phenomena in formal and informal learning spaces, and as part of their everyday lives.

Study Design

The students attended two non-consecutive week long summer camps focused on science and engineering. The first camp focused on traditional practices in science and engineering design (building fish weirs, surveying)

while the second camp focused on discussing science and engineering as tools to resolve environmental problems that are related to the watershed that their community resides on (how would you put the practices together to solve problems). The second camp used story telling as a pedagogical tool to help students put the engineering practices together in order to think through solving environmental problems related to the watershed.

The students' perceptions of science and engineering were gauged using the following methods: After the students discussed several traditional and Eurocentric science and engineering practices during the first camp, they were given a drawing task at the beginning of the second camp. In this activity, students were asked to draw a community that they would like to live in and show in their drawing how science and engineering played a role in their community. The purpose of this activity was to observe student understanding of science and engineering phenomena and also their perceptions of how science and engineering phenomena play a role in their community/everyday lives. This was a group activity, which involved students sharing ideas about science and engineering in order to draw a map of their community. Each group included four to five students. We then conducted delayed post interviews four months after the camp to find out student perceptions of science and engineering phenomena after a period of time, and how students think about science and engineering phenomena as a part of their everyday lives. Although the student drawings were created as a group, interviews about the drawings were conducted individually allowing us to explore individual student perceptions and understandings.

Participants

22 students in grades 4-6 participated in the summer activities. 11 of those students from one of the tribal communities participated in the study.

Results and Discussion

In the drawing activity, when asked to draw a community and show examples of science and engineering in their community, students chose to draw examples of practices that they had learned in the first weeklong camp. For example, some students drew fish weirs in their community as a science and engineering phenomena. They had learned about fish weirs in the first camp. The majority of the students expressed science and engineering as a phenomenon that involves 'building'.

When students were asked in the interview to point out how the science and engineering practices in their drawing played a role in their everyday lives, most of them could not answer the question. For example, students recognized that fish weirs are used by scientists to capture and tag fish. However, they were not able to connect that practice to how fish-tagging helps make management decisions on fishing practices that are a part of everyday life..

Both the interviews and the drawing activity gave us insight into how students negotiate ideas about science and engineering as they move through different living and learning spaces. In the examples discussed above it is clear that the students think of science and engineering as something that they learn at camp. They are not able to make the connection to their everyday lives. Thus one can observe a clear case of parallel collateral learning. In this case the students' ideas of science and engineering remain limited to their experience in the camp. As observed in the delayed post interviews, the knowledge (fish weirs) remains with them in their long-term memory but they are not able to fit the knowledge in their everyday life context.

In the delayed post interviews, some students mentioned houses and cars as science and engineering phenomena in their everyday lives. However, cars and modern time house designs are viewed as concepts grounded in Eurocentric science and engineering phenomena and therefore are difficult to connect to indigenous ways of knowing. This is a problem faced by many designers of learning environments for indigenous students. Using data from the interviews and drawings in this poster we hope to spark a discussion about how to design effective learning environments for helping Native American students learn about their traditional science and engineering practices and connect those practices to their everyday lives. Curriculum designers may consider implementing strategies designed to bridge the gap between Native Americans home culture and the culture of Eurocentric science. This study is a preliminary study and further research is needed to address Native American students' needs concerning culturally relevant curriculum and instruction.

Select References

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