Script — Master's Thesis Digital Story Presentation

Outline of Scenes

1. Introduction
   a. Questions
   b. Tectonic Model insert — questions

2. Background
   a. Story of how I found the fault
   b. Blair witchesque scene of the IslandWood trails coming upon the fault

3. Rationale
   a. Tangible evidence – Tectonic Model insert (Gobert quote)
   b. GLEs
   c. Existing curricula

4. Lit. Review

5. Methods

6. Significant Questions in the data?
   a. What is an earthquake?
   b. What is a glacier?
   c. What is superposition?
   d. Is teaching with tangible evidence effective?

7. Results
   a. 100% change from "I don't know" to "one on top of the other" (superposition)
   b. alternative conception of …Libarkin et.al 2005

8. Conclusion
   a. Question/rationale revisited
   b. Recommendations
   c. Future study

Script

[BEGIN 00:00:00

Introduction—
Title

The Importance of Tangible Teaching in Earth Sciences: A Need for Changes in Existing Curricula

Matthew John Brewer

An Inquiry Project Submitted to the

Graduate Teacher Preparation Masters of Arts in Ed. Program
Center for Programs in Education
Antioch University Seattle

December 2005

Robert Wang, Center for Programs in Education
Tina Dawson, Associate Dean, Center for Programs in Education

In Partial Fulfillment of the Requirements for the Degree of
Master of Arts in Education

Title:

Introduction

Matt:

How do you teach concepts that are beyond human scale, beyond a human lifetime, or are too large to be immediately observable?

How do you visualize something that moves imperceptivity slow yet has catastrophic human potential?

What role does tangible evidence and place-based education have in fourth and fifth grade earth science curricula?

Given the complex, abstract modeling activities needed to comprehend geosciences, what is the most effective way to teach and understand these

complexities? Do the curricula that exist correlate with Washington State Essential Academic Learning Requirements and Grade Level Expectations as well as national standards? What should teachers do with curricula that do not provide enough tangible evidence?
[*Video Tectonic Model insert: Image — inner structure of the earth, 90.jpg, Ambrose Video 2005; Movie — lg01PacN.mov,* Atwater 2002a].

Title:

Background

Matt:

In August of 2003 I was one of twelve new IslandWood Education for Environment and Community Graduate Students following Debbi Brainerd, Founder and Board of Director Chairperson at IslandWood, around the campus. Deep in the woods, disoriented, and overwhelmed, we came around an unexpected corner to find an array of orange construction fencing. The temporary barrier marked a large excavation site and harbored an exposed earthquake fault. At the bottom of the trench we encountered Brian Sherrod, a United States Geological Society Paleoseismologist, who explained what we had before us — a strand of the Seattle fault, and evidence of a shallow megathrust earthquake 1,100 years before present (Atwater and Andrew 1992; Blakely et al 2002; Blakely 2003; Sherrod 2003a; Weaver et al 1999).
[*Video* — Blair Witch Style from Suspension Trail junction to the Fault, *Image* — Sherrod in the Fault]

This unexpected find at a fortuitous moment precipitated excitement among the graduate students, and we drafted a proposal to keep the trench open and to become a teaching resource.
[*Title* — August 24, 2003; Save the USGS Trench: Geological Fault and Soil Stratigraphy Lesson Plans; Presented to the IslandWood Community by the Graduate Students of 2003-2004

Over the following year I devoted classroom assignments and field experiences to the development of lessons that teach geology at IslandWood. The lessons provide a background to understand the recent geologic history of the Pacific Northwest (i.e. glaciers 20,000 years before present), The predominant observable earth movements (i.e. earthquakes and their impact), And an emphasis on how people have been affected and will continue to be affected by as an integrating the use of stewardship, consistent with IslandWood's overarching questions and goals. More information, based on

several questions of inquiry can be found at the following website presentation of my Independent Study Project:
[*Image* — IWGeology_poster; Glaciers.pdf; IWGeology_poster2; Fireplaces_that_teach.pdf; Inquiry.pdf; What_is_Lidar.pdf; Superposition.pdf (Brewer 2004a, 2004b, 2004c, 2004d, 2004e, 2004f, 2004,g, 2004h, 2004i, 2004j, 2004k)
image — http://resources.islandwood.org/geology/questions.htm]

Title

Rationale

Matt:

Existing K-8 Earth Science curricula that teach earthquakes, volcanoes, plate tectonics, and tsunami often require a middle school level understanding. Fourth grade students are able to grasp complex earth science concepts with tangible evidence. What cognitive mental maps do an inquiry-based and place-based learning experiences provide upper elementary (i.e. fourth and fifth grades) students? How does tangible evidence of earth processes enhance student understanding?
[*Image* — FOSS logo, GEMS PT logo, CUES logo, GEMS ST logo, IES logo, EarthComm logo, PES Geology logo; IW_trench_photo.pdf]

My estimation is that upper elementary students who are able to connect geologic processes with tangible evidence are more likely to understand the complexities of the concepts when they are presented later in middle school (AAAS 1993, 2001; CSE 2005; NSES 1995; OSPI 2002, 2005).

A long-term study to follow several individuals over extended periods of time is beyond the scope of this paper. To resolve this dilemma I endeavor a twofold approach: first, I focus my investigation on perceptions of upper elementary students with video interviews both before and after exposure to tangible geological evidence in the School Overnight Program at IslandWood Environmental Learning center. Second, I examine teacher, curriculum designer, and research specialist's perceptions of earth science curricula at both elementary and middle school levels with a questionnaire. The results of the video interviews, teacher's questionnaire, and curricula designers questionnaire will provide an effective means to evaluate student, teacher, and curricula designer perceptions, respectively.
[*image* — Sherrod in the IslandWood fault,
video — instrustion at the IslandWood fault]

Lit. Review

Title:

Literature Review

Matt:

A comprehensive literature review of existing K-8 Earth Science curricula that teach earthquakes, volcanoes, plate tectonics, and tsunami linked with national and state standards revealed a few resources areas that required further attention: environmental education feasibility studies, analysis of state and national standards and existing curricula.

[*Image or video — books flipping?*

Washington State Essential Academic Learning Requirements (EALRs)
Washington State Grade Level Expectations (GLEs)
American Academy for the Advancement of Sciences (AAAS)
National Science Education Standards (NSES)

American Association for the Advancement of Science (AAAS)

(1993). Benchmarks for Science Literacy: Project 2061. New York: Oxford University Press. Pp.66-74. http://www.project2061.org/publications/bsl/online/bolintro.htm

(2001). Processes that Shape the Earth: Changes in the Earth's Surfaces (CS), Plate Tectonics (PT). In Atlas of Scientific Literacy: Project 2061. New York: Oxford University Press. Pp.50-53.

Center for Science Education (CSE)

(2005). *CSE K-12 Curriculum Dissemination Center: Curriculum Profiles*. Available on-line: http://cse.edc.org/pdfs/curriculum/10currprof.pdf. Visited Jan. 1, 2005.

Lieberman, Gerald A. and Hoody, Linda L.

(1998). *Closing the Achievement Gap: Using the Environment as an Integrating Context*. State Education and Environment Roundtable. Updated 12/10/01. URL http://www.seer.org/pages/GAP.html. Visited November 21, 2005.

National Science Education Standards (NSES)

(1995). National Science Education Standards – Contents. http://www.nap.edu/readingroom/books/nses/html/index.html. Visited February 18, 2005.

Office of the Superintendent of Instruction (OSPI)

(2002). Washington State's Essential Academic Learning Requirements. http://www.k12.wa.us/CurriculumInstruct/EALR_GLE.aspx. Updated November 2002. Visited November 1, 2003.

(2005) Science K-10 Grade Level Expectations: A New Level of Specificity.

http://www.k12.wa.us/CurriculumInstruct/EALR/pubdocs/ScienceEALR-GLE.pdf. Updated January 2005. Visited February 1, 2005

[*Image montage created by Matthew John Brewer from the PDF files, images of book titles etc. from similar websites, previously scanned images, and using PowerPoint, iPhoto and the imported to iMovie.*]

Matt:

Through my analysis of the standards defined by the American Academy for the Advancement of Sciences, the National Science Education Standards, and Washington State EALRs I have noted many similarities and discrepancies.

Beginning at third grade all three sets of standards suggest that students grasp how sedimentary processes shape the earth gradually, and the importance of recognizing different rock types (minerals, igneous, metamorphic, and sedimentary). Both the EALR and the NSES agree that students at a fourth grade level recognize that change happens both gradually and abruptly, while the AAAS strangely places understanding abrupt changes at a sixth grade level with more complex understanding of plate tectonics.

Using this framework to teach about a specific earthquake event on the IslandWood ELC campus raises the important question of which standard should be adopted. Even though the AAAS and NSES standards may not be as detailed as the Washington State EALR and GLE, residence and locality in Washington State would necessitate the use of EALR and GLE standards.

Although mastery of the five geologic principles (crosscutting relationships, superposition, original horizontality, original lateral continuity, and faunal succession) is not required until the 10th grade benchmark, developing a solid foundation of these ideas is an essential learning requirement (OSPI 2002, 2005). Understanding these geologic principles are the essence of understanding *processes and interactions in the earth system* [*image* — AAAS (2001), OSPI 2005:11,32-33, Superposition.pdf (Brewer 2004g)

Title:

[Hippensteel 2004]

Method

Title:

Methods — Interviews, Questionnaires & Scientist in Residence

—

What depth and breadth do inquiry-based and place-based experiences provide upper elementary students?

—

How does tangible evidence of earth processes enhance student understanding?

Matt:

In order to answer these questions, I collected data using four approaches: interviews, questionnaires, a comprehensive literature review of existing curricula and standards, and participation in the Scientist in Residence program at IslandWood.

Title:

Interviews of Selected Students
Centered on their IslandWood School Overnight Program Experience

Matt:

Interviews included two groups of selected students who have attended and experienced an IslandWood School Overnight Program (SOP). Interviews questions focused on three themes: how explanations of earthquakes, glaciers, and superposition may be attributed to exposure of an earthquake fault at IslandWood; how conceptions about plate tectonics may arise (adapted from a study posed to College Students about plate tectonics [Libarkin et al 2005]); and how often students' perceptions of teacher efficacy enhances their learning by making concepts too complicated, inviting outside speakers, or going on field trips.

[image — interview questions as pdf]

The first group of 8-10 4th grade students, centered on their 2005 SOP experience at IW ELC, included two group video interviews of 30 minutes each in a pre-IslandWood visit, and the same students in a post-IslandWood interview.

The second group of 8-10 5th grade students reflected on their 2004 SOP experience in a group video, and took no longer than 45 minutes. These students were asked to explain what they remember from IslandWood, shown a video of them at IslandWood, and given a chance to correct and amend previous answers.

[*Video — snapshots of each interview(s)* [effect — fast]; *interviewPPT*]

Title:

Questionnaires for Peer Educators and Curriculum Designers

Matt:

Questionnaires were sent to peer educators and curricula designers about earth science curricula efficacy, variety, and student accessibility.

Questions in the curricula designer's questionnaire focused on organization and design consideration, amount of feedback received from teachers in the field, recommendations for hands-on, inquiry based activities, and a chance to rate the efficacy of other existing curricula.

Questions in the teacher's questionnaire focused on likes and dislikes of curricula used, how often the curricula must be adapted to meet student needs, how often hands-on, inquiry based activities are recommended (and obstacles that may arise), and a chance to rate the efficacy and familiarity of existing curricula.

[*image — questionnaire as pdf*]

Title:

Scientist In Residence at IslandWood (May 23-26)

Matt:

Participation in the Scientist In Residence at IslandWood was in pre-assigned groups, and part of an existing School Overnight Program experience working with pre-assigned schools. I worked with three groups each full field day, for a total of six groups of eight to ten students over the week. During this time, I worked with Brian Sherrod, USGS Paleoseismologist and principal investigator of the IslandWood fault, to create an earth science curriculum consistent with the educational mission of IslandWood and based on four geologic concepts: time, change, cycles, and earth at home (stewardship and mitigation).

[Video — Intro Fault, SIREP (push waves) [effect — fast] *]*

Title:

Decoding and Assistance [*over image below*]

Matt:

During the decoding process, members of the Education Team at IslandWood ELC were asked to observe recorded video segments. Their continued expertise, input, and constructive criticism provided additional relevant insights.

[*image — of IslandWood DSCN0218, DSCN0213, teaching at IW?*]

Title:

Data Presentation

Matt:

Many questions were asked throughout the duration of this project, yet two questions emerge and recur with consistency: How effective is teaching with tangible evidence? What is the best example of teaching with tangible evidence?
Both questions may be answered by asking a third question: What is superposition?

[*excerpt video Superposition.Mov*

Student: Superposition is when the older rock is on the bottom and the younger rock is on the top, man!]

Title:

Results

Matt:

In each interview I asked students, "if you had to explain the word "superposition" to a friend, what would you say?" In nearly all cases students did not know how to define superposition before exposure to tangible evidence, and had a clear, consistent definition after exposure.
[*Image* Table "Tectonic Results"]

Yet, surprisingly, when shown these four figures, and asked to determine which best represents the inner structure of the earth…

…Students chose "B" overwhelmingly. Why is that? What would happen during mountain building, volcanic eruptions, and earthquakes if the plates are not on the immediate surface?
[*Image* Libarkin et.al 2005]

Thus, we return again to the questions raised in the beginning of this presentation: How do you teach concepts that are beyond human scale, beyond a human life time, or are too large to be immediately observable? What is an effective model to explain this complexity?

I have created a companion film, "Tectonic Modeling", to provide detailed analysis effective geoscience modeling.
[*excerpt — Tectonic Models*]

Conclusion

Title:

Conclusion

Matt:

Careful attention to students' cognitive associations and observations of an inquiry-based, experiential learning experience with tangible evidence of processes and interactions in the earth system provides upper elementary students with an opportunity to grasp complex earth science concepts.

At all levels, students must be able to distinguish between the ability to *know* and *describe* as well as *identify* and *explain* geological processes with tangible evidence. Only then will it become increasingly clear that changes on the earth's surface can be slow and gradual (such as weathering and erosion, glaciers, etc.) or sudden and catastrophic (such as earthquakes, tsunami, etc.).

[*image — picture of fault;*

video — excerpt from teaching at the fault; final.mov ( )]

Title:

Recommendations

—

TEACHING WITH TANGIBLE EVIDENCE REQUIRES THAT A TEACHER AMMEND THE CURRICULA TO EMPHASIZE LOCAL FEATURES.

—

THAT MEANS: A TEACHER OF THE PACIFIC NORTHWEST MUST AMEND EXISTING CURRICULA TO INCORPORATE THE LOCAL ENVIRONMENT.

Matt:

While it is essential that instruction be aligned to Washington State Grade Level Expectations National Science Education Standards and American Academy for the Advancement of Sciences Project 2061 Science Benchmarks, it is more imperative that curricula units be designed to develop subject interest with real-life evidence and that they are amended to use tangible evidence present in each locality.

[*image —* EEReportCard914.pdf (OSPI 2004)]

Curricula that currently exist use real-life examples that are sometimes impossible to effectively visualize for students of the Pacific Northwest; for example the Grand Canyon

[*image —*

http://www.cactuscorner.com/Grand%20Canyon/GRANDCYNLG280.jpg]

and the San Andreas fault.
[*image — http://pubs.usgs.gov/publications/graphics/San_Andreas.gif*]

Teachers must find local resources that align earth processes and science standards in order to effectively teach geosciences.

Especially in an urban environment, curricula must be adapted to real-life, tangible evidence that surrounds our homes, neighborhoods, communities, and planet. Without such adaptations, the level of abstract thinking may never be bridged.
[*image — "Roadside Geology of Washington" (Alt and Hyndman 1984) https://id290.securedata.net/facetshoppe/cart/img/43-240.jpg; ErraticDH.jpg; ErraticAS.jpg (taken by Matthew John Brewer)*]

Bibliography

See Master's Thesis, Bibliography Section

END 11:46:00]