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# A study of multimedia in an environmental science course

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A Study of Multimedia in an Environmental Science Course

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By:

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Abstract

This study examined the use of sign movies, content movies, and adjunct questions in an instructional unit for Deaf students taking an environmental science course. Pre and post tests of factual recall as well as an attitude measure were administered to determine if web-based technology benefits Deaf students taking environmental science courses. The results indicate that deaf students learning through web-based technology benefit from embedded American Sign Language explanations and questions as adjunct instructional aids. Implications of using web-based technology are discussed for science teachers having deaf students in their classes.

*Introduction*

Environmental science has been around for 30 years and there are still difficulties integrating environmental education into the classroom (Alvarez, DeLaFuente, Perales, & Garcia, 2002). The benefits from learning environmental science are enormous. Studying environmentally based education encourages integrated learning across disciplines such as chemistry, biology, earth science, social studies, physics and English. It improves problem solving skills, decision making, independent and group learning, issue based activities, and a balanced variety of perspectives, which are linked positively to academic achievement (The National Environmental Education and Training Foundation, 2000). Teachers across the country have seen that students enjoy learning environmental science and it motivates them to learn other subjects because they need the information and techniques from other subjects to understand environmental issues (The National Environmental Education and Training Foundation, 2000). The motivation of the students to learn environmental science will stimulate the student's thinking and interest in other topics which is why it is important for Deaf students to study environmental science. Environment science offers a potential advantage for students to improve their academic skills.

Deaf students who enter college are considerably behind their hearing peers in reading levels. Only 40 percent of Deaf students who enter college have a reading level of above 4$^{th}$ grade and 8 percent of Deaf students who enter college have a reading level above 8$^{th}$ grade (Allen, 1994). A majority of deaf students are now also enrolled in mainstream programs (Marschark, Lang, & Albertini, 2000). Such programs allow Deaf students to take classes with their hearing peers, hopefully with the necessary accommodations such as interpreting, note-taking, C-print (real-time captioning), speech, or teacher of deaf support. Deaf students therefore

are learning among their hearing peers who have a significant advantage with their reading level. Web-based technology needs to be developed in a way that will allow the Deaf students to keep up with their hearing peers in the classroom.

A study by Dowaliby and Lang (1999) indicated that performance scores of Deaf students in science with both low and high reading levels can be improved with the use of multimedia web-based technology that contains text, content movies, sign movies, and follow up questions. Most web-based technology on the internet, however, contains only a simple diagram or a content movie for environmental science. There is little web-based technology that contains the important adjunct instructional aids that will benefit Deaf students. It is necessary to conduct research to see if Deaf students' test performance will increase in learning environmental science topics as it increases in general science fields by using web-based technology.

The present project's two main goals are to determine if the web-based technology that contains text, content movie, sign movie, and follow up questions improves Deaf students' learning in a short unit of an environmental science course, and to determine if the Deaf students enjoyed the learning experience through web-based technology.

## *Literature Review*

### *Impact of Environmental Science on Students in the Education System*

Environmental issues impact human beings on the planet and both Deaf and hearing students need to be aware of the issues. Researchers have indicated that if environmental education is integrated into the education system, the students will have higher overall academic success in reading, science, and math (The National Environmental Education and Training Foundation, 2002). The reason for higher success is because environmental education improves

skills in independent studies and critical problem solving (The National Environmental Education and Training Foundation, 2002). Using environmentally based programs at 40 schools from 12 states, these researchers showed that 77 percent of the students improved their SAT scores, 73 percent improved their grade average, 93 percent improved in reading, 92 percent improved in math, 96 percent improved in problem solving and critical thinking, and 100 percent improved in science learning (The National Environmental Education and Training Foundation, 2002).

Recently a study by Joy Schultz (2004) has shown that Deaf students' attitudes towards environmental learning were enhanced through a curriculum focusing on the environment. In the study, Schultz (2004) found that students did indeed benefit from taking an environmental studies course at associate level "with a statistically significant increase in the mean scores for a pre- and post-evaluation of their attitudes toward the environment." (p. 1). She found that the increased knowledge of issues related to environmental science can lead to the development of more positive attitudes towards the environment. An important point in Schultz's (2004) study is that a "well-designed course with effective instruction can make a difference in both learning and attitudes" and is the key for success (p. 1).

*Issues related to Environmental Science Education*

Even though environmental education began 30 years ago there are still difficulties with integrating the subject into academic programs today. On a positive note, surveys show that 95 percent of the public supports environmental education in schools. On the other hand, 66 percent of adults fail simple tests of environmental knowledge (The National Environmental Education and Training Foundation, 2002). The main reasons for the failure in environmental education are lack of preparation and awareness among the teachers with environmental issues (Alvarez et al.,

2002). Studies have shown that only 10 percent of all the teachers in the secondary education level who teach environmental science have a background in environmental science (North American Association for Environmental Education, 2002). One study by Alvarez et al. (2002) discusses how there must be a model to integrate classroom and environmental problem solving so the students can efficiently learn about environmental issues. These authors summarize that there must be a program to teach educators how to teach the students environmental issues the most efficient way (Alvarez et al., 2002).

*Use of Web-based technology for Educating Deaf Students*

Since the mid 1990's technology has offered opportunities for using video, text, graphics, and communication for Deaf education (Akhtar, 2003). Using web-based technology to support Deaf students has been around for more than 10 years. The web-based technologies provide new visual resources for the field of education. The technologies "allow the teacher to go well beyond drill-and-practice approaches, into areas that can stimulate critical thinking and a wide range of communication skills" (Harkins, Loeterman, Lam, & Korres, 1996, p. 59). Lang and Steely (2003) also write in their summary of research on web-based science for deaf students that "Educational technologies often involve the kind of learning activities, interaction, and opportunities to accommodate individual needs that may be of immense benefit to deaf learners" (p. 277).

With the number of Deaf students currently in mainstream programs on the rise, it is important to find a way to use web-based technology to keep Deaf students at the same level as their hearing peers. A review of web-based science instruction by Lang and Steely (2003) summarized that, " well-designed, proven-efficacious science instructional programs for hearing students can be successfully adapted for use with deaf students by interspersing text and ASL

explanations with content animation and by providing additional practice on vocabulary and content graphic organizers" (p. 295). Their analysis of four empirical research studies shows that web-based technology can be successful for Deaf students in a classroom if the teacher effectively combines text, ASL explanations, graphics, and adjunct questions.

Dowaliby and Lang (1999) researched the benefits of using a computer based science lesson under five conditions: text only, text and content movies, text and sign movies, text and adjunct questions, and all of the above. The results of the study indicated that the adjunct questions led to a "significantly greater factual learning, overall, than any of the other conditions" (Dowaliby and Lang, 1999, p. 278). An interesting part of the study was that as isolated conditions, text, sign movies, and the content movies did not lead to a statically significant difference in factual recall by low-ability readers. It is probable that these instructional aids when acting alone "did not induce learner engagement" (Dowaliby and Lang, 1999, p. 279). In contrast, the adjunct questions made the Deaf students actively think about what they were learning and allow them to understand the materials while paying more attention to facts instead of passive viewing of the text and movies.

Scott Whitney (2002) used games to teach vocabulary terms and found that Deaf students enjoy using computer multimedia technology. Even though the multimedia did not benefit all the Deaf students, it was shown that the attitude towards the multimedia technology was positive and it helped some Deaf students to recall the vocabulary terms for some students (Whitney, 2002).

Students should learn to "do science" rather than just "learn about science"," is an important emphasis found in environmental science instruction (The National Environmental Education and Training Foundation, 2000, p. 10).

## *Method*

### *Participants*

The participants in the web-based technology study were 38 deaf and hard of hearing college students who attend the National Technical Institute for the Deaf (NTID), which is one of the eight colleges at Rochester Institute of Technology. Twenty-one of the students who volunteered to participate in the study were enrolled in an Environmental Studies course. Seventeen of the students who participated in the study were taking Astronomy at the time of this study. The students are taking the courses as a science elective offered by NTID in order to graduate with an associate degree.

### *Materials*

The web-based science lesson was designed to be studied under four different conditions: A) content movie, B) content movie and sign movie, C) content movie and adjunct questions, and D) content movie, sign movie and adjunct questions. The content movie was found on the NASA's Earth Science Enterprise Water and Energy Cycle (GWEC) website, http://watercycle.gsfc.nasa.gov. The animated movie shows the entire water cycle process from beginning to end. During the movie, simple text labels identify the key terms of the water cycle. These key terms have no descriptions attached but merely give technical names to the animated processes shown in the movie. For Condition B, the sign movies were added to the web-based content movie. The student was able to click on the key technical terms and see an ASL description of the terms. For Condition C (see Appendix C), the adjunct questions were added to allow the students to actively participate in answering questions about the key vocabulary. The questions were different from the pre- and post- test items but were related to the concepts being

learned. The technical terms that the Deaf students were learning in the water cycle lesson included condensation, precipitation, evaporation, transpiration, surface runoff, percolation and groundwater (Appendix A).

On December 4, 2004, the Rochester Institute of Technology Institute Review Board (IRB) approved the proposal for this research study.

*Procedure*

The web-based science lesson took approximately 45 minutes for the students to complete. The students were given instructions which clearly explained the steps of the study. Prior to the lesson the students took a pre- test (see Appendix B). The pre-test contained a total of 12 multiple choice questions. Seven of those questions were taught using the web-based technology while the other five questions, even though related to the water cycle, were not taught using the web-based technology. After the pre- test, the students were separated into the four different groups. As shown in Table 1, there were between 8 and 11 participants in each group. These participants were assigned to the four conditions through stratified random sampling based on their NTID reading scores. The reading score means for groups A, B, C, and D are 116, 118, 116, and 120, respectively.

Group A students watched the content movie and then completed the post test, which was exactly the same as the pre test. Group B watched the content movie and the sign movies on the web, then completed the post test. Group C watched the content movie and the adjunct questions, then completed the post test. Group D watched the content movie and sign movie, answered the adjunct questions, and completed the post test. All students also were given survey questions to see if they enjoyed using web-based technology to study the water cycle (see Appendix D).

A Repeated Measures Analysis of Variance (ANOVA) was conducted to determine whether the web-based technology had any impact on the Deaf students' learning.

*Results*

The ANOVA indicated a significant difference ($p < .0001$) between the pre- and post-tests. Group B (movie and sign explanations), group C (movie and adjunct questions), and group D (movie, sign explanations and adjunct question) all showed statistically significant gains ($p<.05$). Group A (movie only), however, had no significant difference between the pre-test and post-test, $p = .80$.

An interaction effect was also found ($p<.047$). Comparing the results of the post-tests, both group B and group D had means significantly higher than Group A. Group C approached significance ($p = .057$) compared to group A on the post-test. Table 1 shows the means, and standard deviations for the pre-test and post-test scores for each group. Figure 1 presents these findings visually.

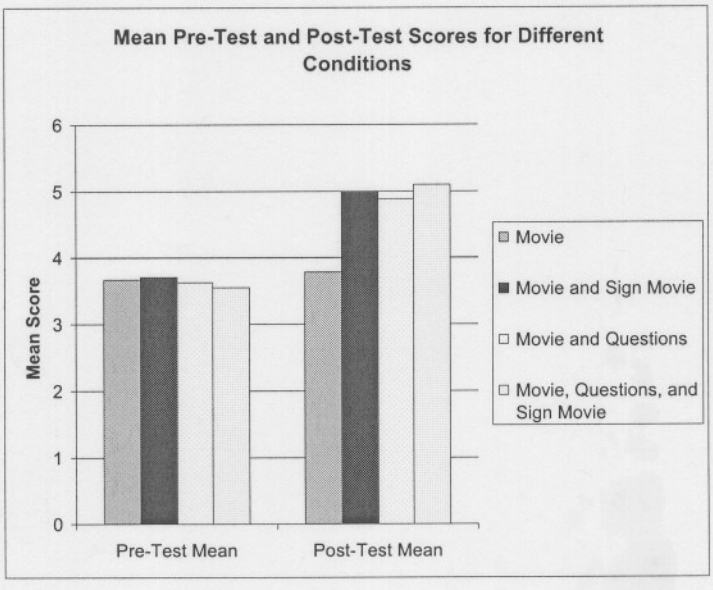
Table 1: Means and Standard Deviations for the Seven Target Items

| | Pre-Test | | Post-Test |
|---|---|---|---|
| | n | M (SD) | M (SD) |
| Group A (Movie Only) | 9 | 3.67 (1.41) | 3.78 (1.48) |
| Group B (Movie & Sign Movie) | 10 | 3.70 (1.06) | 5.00 (1.25) |
| Group C (Movie & Questions) | 8 | 3.63 (.740) | 4.88 (1.13) |
| Group D (Movie, Questions, and Sign Movie) | 11 | 3.55 (1.81) | 5.09 (1.76) |

*Attitudes*

The participants were also asked if they enjoyed learning through the web-based technology. The scale ranged from 1 (not at all) to 5 (very much). The mean score of the survey was 4.33 which indicate the students enjoyed the web-based instruction.

Figure 1:




*Discussion*

The results of this study indicate that deaf students benefit from using multimedia lessons. The use of adjunct aids such as sign explanations and questions, which encourage cognitive engagement, were found to be especially important for reinforcement. Learning only through a high-quality web-based movie on the water cycle was not sufficient. There was no significant pre-test-post-test gain. Group B, C, and D all which had adjunct reinforcement to the movie experienced much higher gains between the pre-test and post-test.

Group C (adjunct questions) approached significance in the comparison with Group A on post test scores. These results may have been due to the low N's in this study. The results show that deaf students need more than a movie to fully understand the concept being shown. The results of this study also support the findings of Dowaliby and Lang (1999) and Lang and Steely (2003) that advocate the use of combining various adjunct instructional aids in multimedia lessons in science. Finally, the present study demonstrates "ecological validity" in that it was designed and conducted by a classroom teacher in authentic science environments.

The attitude questions given to the students indicated that they enjoyed learning from the web-based technology. Most of the students' comments were related to the ASL explanations of the water cycle processes. The students enjoyed the interface of the web-design because the graphics were clear and easy to use and the technical terms were strategically placed on the water cycle photo map. The advice the students offered for improvement of the lesson was to add text below the signer for reinforcement to the sign movie. Some students commented that they were already aware of the topic and it was a good review for them. Future research should include studies with larger numbers of subjects using topics that are more difficult.

In summary, this study has implications for teachers of Deaf students who use sign language. Such students will benefit from a web-based technology that has clear ASL explanations of the vocabulary on a high speed internet, along with adjunct questions which reinforce learning by cognitively engaging the students in interpreting what they are viewing or reading.