WORLD WIDE WEB AS A RESEARCH TOOL FOR SELF MOTIVATED LEARNING OF OZONE

By

KIM HANNA *

* Assistant Professor of Science Education, School of Education, DePaul University.

ABSTRACT

Student use of computers and the internet has increased rapidly in recent years. Teachers ask what types of learning experiences can be facilitated by using the internet in their classrooms (NSBF, 2007). Various surveys of U.S. teachers on internet usage report that having students use the internet for research and information gathering purposes is its most common use (Becker, 1999; Mistler & Songer, 2000; NSBF, 2007). Although use of the internet is popular among educators and students, the theoretical and empirical foundations for its use have not been firmly established. This study investigates the use of the World Wide Web (www) as a research tool to promote self-directed learning of ozone for fifty-two middle school students. Performance of pre-and post-tests were used to determine the effectiveness of www in enhancing students' understanding about ozone; attitude questionnaires were used to ascertain positive/negative effects on student learning using the www. The results showed many positive aspects of using the internet for self-directed learning of ozone, including significantly increased student understanding of abstract science concepts and motivation in taking responsibility and control over one's own learning.

Keywords: Science Learning Using Computers, www Learning, Internet as a Research Tool.

INTRODUCTION

Purpose of the Study

The internet is a computer-based technology, and resources on the internet continue to proliferate at a rapid rate. One of the best-known internet systems is the multimedia information system called the World Wide Web (www). www technology enables users to navigate on the internet easily, making the www as a tool by which students can apply their research skills to construct an understanding of scientific knowledge.

Classroom teachers, including this researcher, often encourage students to use the internet to find useful information during or after science lessons. Various surveys of U.S. teachers report that having students use the internet for research and information gathering purposes is most common (Becker, 1999; Mistler & Songer, 2000; NSBF, 2007).

Although use of the internet is prevalent among educators and students alike, the theoretical and empirical foundations for its use have not been well-established. Most studies regarding www technology have focused on web-based instruction in the delivery of course information (Ng & Gunstone, 2002; Wallace, 2004). Ng and Gunstone (2002) investigated the effectiveness of www in learning photosynthesis and respiration. They discovered that www learning motivated and helped students' learning of abstract science concepts.

There are few published studies on the effectiveness of the www as a research tool, especially in the field of science education. Given the number of recent reports (Debell & Chapman, 2005; Kleiner & Lewis, 2003; Mistler & Songer, 2000) that call for researchers to establish a theoretical foundation for using the internet as an educational tool, this research was relevant.

Since "good ozone" (stratospheric ozone) and "bad ozone" (tropospheric ozone) are both abstract concepts, students tend to misunderstand them. Teaching these concepts effectively may require additional effort (e.g., technology) so that students can change their misconceptions, if they have any, and learn these concepts correctly (BAESI, 2004; Meadows &

Wiesenmayer, 1999).

The purpose of this paper was to investigate the impact of WWW as a research tool and motivational force in the self-directed learning of "good ozone" and "bad ozone" in a group of 7th grade students.

Research Questions

The study investigated the following research questions:

By using the www, do students learn selected science concepts regarding ozone on their own?

What are students' attitudes (e.g., positive/negative opinions) about using the www as a research tool to learn science concepts regarding ozone?

What type of relationship exists between students' attitudes toward www learning and their performance on selected science concepts regarding ozone?

Methods

The research subjects for this study were fifty-two 7th grade students (30 female & 22 male) from a public middle school in a large, urban district. The subjects were a mixed ability group who attended an after-school science program. The majority of the students felt comfortable using computers based on the student demographic survey given prior to the performance pre-test. They reported that the internet makes information easily accessible and is a fun tool for chatting, playing games, and sending email, regardless of whether they had computers at home. Generally, the students' basic computer skills were proficient because they had been previously exposed to core course curricula (language arts, science, and social studies) which were often integrated with technology.

This study was conducted as a part of the "Earth Science" lesson. Data was collected using three instruments: a performance pre-test and post-test about selected science concepts, and a questionnaire about attitudes toward WWW learning. The performance pre-test and post-test included the same questions. The pre-test was administered at the beginning of the study to determine prior knowledge of the topic being learned. The post-test and attitude questionnaire were administered at the conclusion of the WWW task. Content validity and construct validity of the performance post-test and attitude questionnaire was established by expert reviews (2 science education professors and 2 middle school earth science teachers). Reliability was determined for both performance and attitude instruments after a pilot study. (α = . 81 and .72) using Cronbach's alpha method. Two questions on the attitude questionnaire were (question 1 and 5) modified after the pilot study. Original choices for question 1 were 4-Absolutely Possible, 3-Little Possible, 2-Not Possible, and 1-No Opinion. Modified choices were 3-Absolutely Possible, 2-Somewhat Possible, and 1-Not Possible. Question 5 was rephrased to help the students understand the question more clearly.

The internet was the only tool used to learn about ozone during the study; supplemental resources such as textbooks were not available to students.

The performance pre/post-test consisted of four questions. Each question was worth 10 points making the questionnaire a total of 40 points:

What human health problems are associated with high levels of ground-level ozone? Name at least two.

How is ozone produced in the Earth's lower atmosphere?

Scientists refer to two types of ozone: "good ozone" and "bad ozone." What does this mean?

Please draw a picture showing the Earth and the first two layers of the atmosphere (the troposphere and the stratosphere), as well as a satellite in space and the sun in the background.

The attitude questionnaire, consisting of five questions along with demographic information, was administered at the end of the study. The items were as follows:

Do you think it is possible to learn on your own, using the computer to assist you and using the internet (WWW) to do research and find information (A. a choice of Absolutely Possible, Somewhat Possible, and Not Possible; B. explain how)?

What are the advantages and disadvantages that you have found with using the internet to find information?

If you had the choice of using either the internet or books to do this ozone research project, which would you prefer to use? Please explain why.

Is it better to have been taught "good ozone" and "bad ozone" the traditional way, that is, the teacher tells you what to do, take down notes, answer questions, etc. as opposed to researching to find the answer on your own?

5. If you had to study ozone again, how would you want the teacher to teach it so that you could best understand the concepts?

Since the focus of this study was on the experiences of students using the www as a research tool, they were not provided with any URLs (universal resource locators) to assist them with their search. The researcher and a classroom teacher were available only to guide the students' research and monitor the performance and attitude questionnaires during the five-hour research period.

Results

Summaries of students' responses are divided into the two general areas upon which the performance post-test and attitude questionnaire focused.

Students' Learning of Selected Concepts of Ozone Using the WWW

Most students used a search engine called *Jeeves* as their primary search engine since they often used it in other technology-integrated courses. During the search, they tried "ozone" as a starting search term. When they realized that too many web sites were identified through "ozone", they narrowed the search by using more specific terms or by combining several key words to get better results (e.g., what is ozone, ozone problem, human health and ozone, good ozone, bad ozone, and earth & ozone). They tended to view several sites to understand the concepts of ozone and ozone-related issues.

A performance pre-test administered at the beginning of this study indicated that these students had little or no prior knowledge of the topic being studied (Table 1).

Students were not able to make any guess on the pretest questions which were all open ended, not multiple choice questions. A paired-samples t-test (Table 2) was conducted to evaluate whether or not there was a significant increase in students' knowledge about selected concepts of ozone after the WWW learning. The mean scores on the pre and post knowledge tests were 8.31 (SD= 1.58) and 35.89 (SD= 2.18). There was a significant increase in students' content knowledge after participating in the WWW learning, $t(51) = -163.65$,

	Pre-Performance Test	Post-Performance Test
Question 1 Human Health Problem	I don't know.	Lung damage and respiratory problems.
	Atmosphere and oxygen	It would destroy animal tissue, skin cancers, and cataracts.
	n/a	ultraviolet radiation, sun rays, skin cancer.
Question 2 How is ozone produced in Earth's lower atmosphere	I'm not sure	It's created when a single oxygen atom joins with an oxygen molecule to form ozone.
	n/a	Most ozone found in our atmosphere is formed by an interaction between oxygen molecules and ultraviolet radiation emitted by the sun.
	because people use Hair spray and the thing losses the layer on the earth.	Most ozone found in our atmosphere is formed by an interaction between oxygen molecules and ultraviolet radiation emitted by the sun.
Question 3 Good & bad ozone	n/a	Bad ozone refers to ozone near the ground-its a product of pollution. Good ozone refers to ozone high in the atmosphere where it blocks potentially harmful ultraviolet energy from reaching the ground.
	It means that the ozone is being damaged by Pollution, which makes bad ozone.	The difference between good and bad ozone is that good ozone is mother nature's purifier. It is produced by lightning and by ultraviolet radiation; it purifies our environment naturally. Bad ozone is actually smog. It is polluted ozone. It has the same relationship to pure ozone that polluted water has to pure water.
	The good ozone is good and the bad ozone is bad	Troposphere is the bad level. It's bad because of motor vehicles, industrial commercial processes, and consumer solvents. Stratosphere is the good level help solvent cleaning products, refrigeration and air conditioning, sterilization, other products including (indecipherable).
Question 4 Draw a picture of 2 layers of the ozone, the Sun, and a satellite.		

Table 1. Students' Performance Pre- and Post-tests Responses Sample

p<.0005 (two-tailed). The result indicated that students could learn targeted basic ozone concepts including human health problems, formation of ozone, and understanding of "good" and "bad" ozone independently through use of the Internet.(Figure 1)

Students' Attitudes about using the WWW as a Research Tool to Learn Science Concepts regarding Ozone (e.g., positive/negative opinions of using the WWW).

Independence of Learning

Forty-nine of the 52 students responded that it was absolutely possible to learn on their own using a computer and the internet to do research and find information. Two thought that it might be slightly possible to find information over the computer and internet; one indicated that he might not be sure whether or not the information from the computer was correct. However, the majority of the students agreed that it was possible to find all of the information independently using the internet.

Advantages and Disadvantages of Using the WWW in Researching for Information

Ninety percent of the students said that the WWW was very useful and fast, an easy tool for finding information, and very exhaustive. They indicated that using the internet was more divergent than using a textbook. Regarding

disadvantages, three of them said that the internet gave more information than was required, and sometimes did not address the main point. Some also mentioned that it might be only slightly possible to find information using the computer and internet because they were unsure as to whether or not the information obtained from the internet was correct. Additionally, several students complained that sometimes the internet/computer had frozen and some sites took too long to load.

Preference of Learning/Teaching Format

During the study, all of the students used the internet to do research on the ozone; however, students were asked whether they would prefer to learn about science concepts using the internet or textbooks. Forty-four students felt that they would use the internet to do an ozone project, as they either had easier access to the internet or could find a lot of information quickly, easily and conveniently on the internet (Figure 2). Students liked that there were a large number of pictures and that they could view video clips via the internet. Five said that they would prefer to use both the textbook and the internet for the project. Three wished to use the textbook, indicating that it would address the main point; the textbook was perceived as more likely to be correct as compared to the internet.

Overall students' attitudes (e.g., positive/negative opinions) about using the WWW as a research tool to learn science concepts regarding ozone were very positive. Students enjoyed using the WWW because they believed it was possible to use it as a research tool that gave them useful and easy access to a multitude of information.

				Paired Differences				
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference (Lower)	(Upper)	't'	df	Sig.-(2 tailed)
Pair 1 Pre_test-post_test	-27.587	1.216	.169	-27.925	-27.248	-163.648	51	.000

Table 2. Performance Pre and Post Test Results Paired Samples T-test Analysis
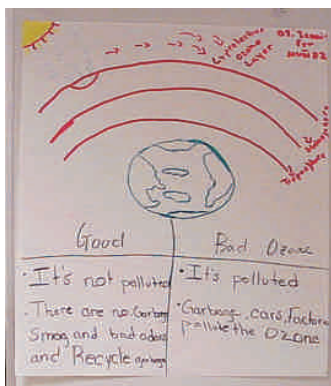

Figure 1. A student's drawing sample of "good" and "bad" ozone.

Figure 2. Students' learning of ozone using the WWW.

Although several limitations presented themselves during the study, most students preferred to use the www rather than traditional methods of learning such as textbooks.

Relationship between Subjects' Attitudes toward www Learning and Their Performance on Selected Science Concepts Regarding Ozone.

The relationship between the performance post-tests and attitude questionnaires was investigated using Pearson product-moment correlation coefficient. There was no significant correlation between students' attitudes toward internet learning and the post-test scores ($r = .26$). In the study some of students received low scores in the performance post-test regarding selected ozone concepts even though they had highly positive attitudes toward internet learning.

Conclusions/Implications

The reflective responses of a group of 7th grade students on their experiences in using the WWW as a research tool in this study have shown many positive aspects for self-directed learning of science concepts. These include increased student motivation in terms of ability to take responsibility and control over one's learning. Most of the students preferred the internet as a learning tool compared to a book, as they either had easier access to the internet or they could find a lot of information quickly, easily and conveniently on the internet. Ninety percent said that they would prefer to use this open learning approach over the more traditional method if they had to learn about ozone again. Students believed that they were more engaged in their learning when they had to process information while researching on the WWW as opposed to obtaining information from the textbook which they had experienced in previous science lessons. However, student perceptions of the task have raised a number of issues. Several students, including two ESL (English as a Second Language) students, pointed out limitations of the WWW as an information provider, including the unstructured nature of the WWW as well as the enormous number of websites with information relevant to the topic being studied. Teachers need to understand that there are still some students who do not

feel comfortable using WWW technology for their learning. Knowing each student's learning style, their abilities to research and validate the information being provided using the technology and a teacher's role as a facilitator is crucial to students' learning success.

Students showed a significant increase in their content knowledge of ozone related concepts after the www learning. However the performance post-test in this study did not focus on measuring students' critical thinking/problem solving abilities using the www, but rather covered basic concepts required by district curriculum. Extensive studies on how middle school students use the www to carry out inquiry-based assignments are still needed.

On a final note, further research with an increased number of subjects considering students' demographics (e.g., gender, availability of the internet at home, level of computer skills, English language ability, and urban/rural schools) might be of interest to a broad base of educators, researchers, and school administrators who are particularly interested in how students' backgrounds can affect their learning using the internet/technology.

References

[1]. **Bay Area Earth Science Institute (2004).** *Ozone depletion: misconceptions.* San Jose State University, Retrieved March 3, 2009, from http://www.met.sjsu. Edu / baesi/

[2]. **Becker, H. J. (1999).** *Internet use by teachers: conditions of professional use and teacher-directed student use.* Irvine, CA: Center for Research on Information Technology and Organizations, University of California, Irvine, and the University of Minnesota, Retrieved May 28, 2008, from http://www.crito.uci.edu /tlc / findings/internet-use/text-tables.pdf.

[3]. **DeBell, M., and Chapman, C. (2005).** *Computer and internet use by students in 2003* (NCES 2006065). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved October 20, 2008,from http://nces.ed.gov/pubsearch/pubsinfo.

Asp?pubid=2006065.

[4]. Kleiner, A., and Lewis, L. (2003). *Internet access in U.S. public schools and classrooms: 1994-2002* (NCES 2004-011). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved June 23, 2008, from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2004011.

[5]. Meadows, G., & Wiesenmayer, R. (1999). Identifying and addressing students' alternative conceptions of the causes of global warming: the need for cognitive conflict. *Journal of Science Education and Technology*, 8(3), 235-239.

[6]. Mistler-Jackson, M., & Songer, N. B. (2000). Student motivation and internet technology: Are students empowered to learn science? *Journal of Research in Science Teaching*, 37(5), 459-479.

[7]. National School Boards Foundation. (2007). *Research and guidelines for children's use of the internet.* Retrieved April 18, 2009, from http://www.nsbf.org/safe-smart/full-report.htm#sum.

[8]. Ng, W & Gunston, R. (2002). Students' perceptions of the effectiveness of the world wide web as a research and teaching tool in science learning. *Research in Science Education 32*, 489-510.

[9]. Wallace, M. (2004). A framework for understanding teaching with internet. *American Educational Research Journal*, 41(2), 447-488.

ABOUT THE AUTHOR

Dr. Hanna Kim is an Assistant Professor of Science Education at DePaul University. She teaches primary and secondary science education courses for undergraduate and graduate students. Her research topics include science and technology integration, and student misconceptions in science. She serves as the Program Director of the InSTEP (Inquiry Based Science and Technology Program) for middle school female students.