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Technology Integration in Environmental Education

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As technology continues to be integrated into every facet of our lives, we must take a serious look at the benefits of this integration. Specifically, in education, we must examine how we are using technology in our curriculum and determine what benefits our students will receive from its use. Traditionally, when we thought of technology use in classrooms, we thought of skill development in the areas of math and reading. However, as technology has evolved we have seen its application in less likely areas of the curriculum such as Environmental Education (EE).

Integrating technology into the study of the environment requires a delicate touch in order to preserve the integrity of nature while utilizing the benefits of technology. As Burniske (2005) states “strive for balance between computer-assisted and real world learning; for every hour of high tech, make sure young learners receive one hour of high touch” (p. 51). Further, Burbules & Callister (as cited in Burniske, 2005), explain that the use of technology must be seen as not only a set of tools for learning but also an environment for interaction.

The purpose of this paper is to review research in the use of technology in the area of Environmental Education and examine some of the implications of that research.

The use of handheld devices

Environmental Education and handheld devices or PDA's seem to be a natural fit due to their portability, social interactivity, context sensitivity, connectivity and individuality (Klopfer & Squire, 2008). Yet, according to a study by Parr, Jones and Songer (2004), the study of classroom use of PDA's remains poorly studied. Specifically, there is little research on the effectiveness of PDA's for specific educational purposes and the need to design custom PDA software for educational goals is at the beginning stage. Often, PDA's are used solely for data collection as the PDA provides a fast and accurate way of aggregating data (Parr, Jones, &

Songer, 2004). A study of fifth and sixth grade students using an icon driven PDA interface (the BioKIDS Sequence) found that students were able to enter data more quickly and the use of PDA technology supported the use of scientific reasoning (Parr, et al., 2004).

In a design experiment study with high school and college students using a PDA game software called Environment Detectives, researchers found that the classroom culture played a major role in the way that the software was used and what students gained from the experience (Klopfer & Squire, 2008).

Celeste Oprean, a teacher in Hendersonville, North Carolina, used handhelds (Palm PDA with a probe) with third and fifth grade students in a study of acid rain. Students took water samples and recorded their data using the PDA. Students were trained in the use of the PDA's by pre-service teachers and learned how to enter data, use the probe and beam information between PDA's (Ritter, 2001). At the end of the study it was concluded that this was a "meaningful integration of technology and core curriculum" (Ritter, 2001, p.18) and that students increased their understanding of acid rain however, no specific data was presented to show that increase. The researchers concluded that high interest from teachers and collaborative work with students contributed to the project's success (Ritter, 2001).

Simulations and achievement

Computer simulations are a common means for integrating technology into the curriculum. In environmental education, simulations can be especially helpful when students do not have access to the "real thing" such as a stream or forest. However, does research show that simulations bring about an increase in achievement? In a study by Fortner, et al., (1986), it was indicated that simulations did not bring about a marked difference in higher cognitive processes but they did appear to be more effective in teaching factual recall than the workbook modules

used by the control group. And, a major benefit of the computer simulation was the discussion that arose afterward (Fortner, et al., 1986).

Web-based instruction and knowledge

In a study conducted in 2006 by Aivazidis, Lazaridou and Hellden, traditional and web-based versions of an environmental education program were compared in order to determine the effectiveness of raising knowledge and attitudes of environmental issues. The researchers found that students who received the web-based instruction significantly outscored their traditionally instructed peers in knowledge and in attitudes toward the environment. All groups showed positive attitudes toward the environment yet, it was noted that the treated group (web-based instruction) showed a statistically significant but low correlation between knowledge and attitudes (Aivazidis, Lazaridou, & Hellden, 2006). The researchers also noted that an important factor of environmental education is the development of a feeling of interrelatedness. They found that the effective use of information and communication technologies (ICT) in a supplementary manner to hands-on teaching would benefit the curriculum (Aivazidis, et al., 2006).

Environmental software/programs

Map making software such as ArcExplorer can be downloaded for free in order to improve visual connections to the geography of the area being studied (Smith, Edwards, & Raschke, 2006). In fact, the use of Geographic Information System (GIS) software may help students gain insight and a higher level of understanding (Smith, et al., 2006). One study on the use of Columbia River Basin Environmental Research Project (CERP) curriculum examined whether college level students learned and applied the skills from the CERP curriculum. Initial findings indicated that students were able to complete modules using map-making software without learning map-making skills (Smith, et al., 2006). Additionally, students did not receive a

grade for the activity and this may have contributed to students taking more interest in changing the colors and patterns of the maps than in acquiring knowledge about the maps (Smith, et al, 2006). However, as the study progressed into the second year of implementation, a comparison of pre- and post-test results showed that students began making significant gains in four questions/content areas: the role of groundwater, natural influences on water quality, effects of excess phosphate, and the sources of phosphates (Smith, et al., 2006). There was not a significant gain in student's ability to read maps but the researchers state that this may be due to the simplicity of the questions (Smith, et al., 2006).

In another study, GIS systems were used in a two-year study in a middle school setting to determine how they might enhance science education (McWilliams & Rooney, 1997). Students used the GIS equipment to study the water quality of a highly polluted river. It was hoped that students would use the GIS systems to learn about spatial aspects of the river and investigate information that they otherwise would not have access to. At the time of publication, preliminary study findings indicated that students had increased levels of spatial attention/awareness, organized their data, and had increased levels of engagement with GIS technology. Other improvements were cited as well (McWilliams & Rooney, 1997).

Videoconferencing

The Youth Network for Healthy Communities (YNHC) project uses videoconferencing technology as a means for students to share the results of their studies in environmental health topics. Once students have completed their research, they present their final project live via videoconference and are evaluated by a panel of experts (Sedlacek, Young, Acharya, Botta, & Burbacher, 2005). Results indicate that students take these presentations seriously and use effective communication to share their findings due to the presence of the video cameras. When

evaluated, teachers and students have responded positively to this integration of technology however, there has not been definitive measurement of the knowledge gains that students have made (Sedlacek, et al., 2005).

Student achievement

In other studies, (Disinger & Fortner, 1984; Fortner, et al., 1986; Schacter, 1999) student achievement was discussed and reference is made to the meta-analysis of research that was conducted by Kulik, Bangert and Williams in 1983 and Kulik in 1994. This meta-analysis looked at studies of computer use with students and found that there were positive relationships between computer use and student attitudes in some groups of students. In fact, Fortner, et al., (1986) cite the Kulik analysis as showing an increase in student's final examination scores due to computer-based instruction. And Schacter (1999) summarizes that students learn more quickly when using computer-based instruction.

Conflicting information/concerns

In the case of the CERP study (Smith, et al., 2006), the researchers found that while students faced issues that can cause frustration while using technology, the CERP students did not become frustrated. This was attributed to "small class sizes and a low student-to-faculty ratio" (p.254). This finding raises the question as to whether the improvements were due to the implementation of technology or the shift in instructional strategies (i.e., small class sizes and group work). Smith et al. (2006) conclude by stating that "understanding how technology impacts student learning still remains an open question" (p. 255).

In other research (Fortner et al., 1986; Ritter, 2001) there are conflicting results with some indicating an increase in higher level learning and knowledge and others showing only an increase in attitudes towards technology.

Conclusion

So what does this research mean in terms of practical application? And what are the implications for teaching and learning about environmental education with technology? We can conclude that additional research must be done specifically in the area of environmental education (EE) to determine the true impact of technology on EE. Further, collaboration and classroom environment may be contributing factors to the successful integration of technology in EE. Although influences may be difficult to isolate, future studies should be developed to disaggregate factors that may be skewing results. Researchers need to continue to examine the influence of technology on the environmental curriculum and identify areas where knowledge as well as attitudes might be increased. Furthermore, studies may well prove that the effects of integrating technology (or different types of technology) into environmental education result in different data sets than integration of technology into other curricular areas. As research is conducted, it is important to keep in mind that “ICT can only enable effective learning to happen; they do not cause it to happen” (Aivazidis, et al., 2006, p. 53). This mindset should lead researchers to effective and comprehensive evaluation of the integration of technology.

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