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ELECTRONIC NETWORKS IN SCIENCE EDUCATION

A Literature Review

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ABSTRACT

Electronic networks in science are emerging as a new way to create highly interactive environments in which information can flow in many ways. In addition it has been found that teachers and students develop new instructional strategies and classroom organization when participating in telecommunication projects. A wide variety of telecommunication projects are explained including tele-apprenticeships, problem solving, and scientific investigations. Research is reviewed and indications are that electronic networks are one way to enhance science learning and teach students how to effectively communicate in a technology-based society.

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Technology and its role in education are emerging as an important topic for the next century. The National Science Education Standards (NSES, 1996) state that the major goal of science education is to produce students that are scientifically literate and technologically informed. Many literary scholars are predicting a paradigm shift as students become linked to the world beyond the classroom (Dillan & Gabbard, 1998). However, there remains a tremendous need for a richer understanding of the learning process and how it relates to technology education. The use of technology as a means of information creation and the potential for learning **with** technology and not just **from** it need to be considered (Dillan & Gabbard, 1998).

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[AT&T Learning Network](http://www.att.com/learningnetwork/)
(http://www.att.com/learningnetwork/)

Electronic networks are emerging as a possible way to create highly interactive environments in which information can flow in many directions. These networks create "microworlds" of highly motivational learning contexts for teachers and students. Students and teachers are motivated to collaborate on projects in different locations and share their results with a wider audience (Levin & Thurston, 1996). Students become motivated and excited when they receive immediate feedback about their work. For example, students can collaborate on projects such as the AT&T learning network (Riel, 1990) in which teachers joined students and others to search for information and explore a variety of topics. These classes developed new instructional strategies and classroom organization in order to be able to effectively telecommunicate with each other. Teachers and students worked in teams to solve real problems, share cultural perspectives and learn from one another. They collected data, conducted interviews and surveys, and analyzed the data to draw conclusions that are significant to the adult world (Riel, 1990). The AT&T Learning Network involved university researchers, students, teachers, and pre-service teachers who communicated electronically and collaborated on a variety of subjects such as a study of career choices and how they changed across generations, comparisons of news coverage of world events, a study of how the water cycle operates in different places and techniques for dealing with water shortages, comparisons of food prices and import/export policies, and comparisons of TV watching patterns (p. 165). Schools worked closely with site coordinators to organize the schedules of the projects. This concept has also been applied to the Long Distance Learning Network (LDLN) and has connected hundreds of teachers from the US, Canada, Holland, France, Germany and Australia into networking units of 6-10 classrooms with specific goals and curriculum-based tasks to be complete. The design and development of the LDLN and the AT&T Network show that successful telecommunication networks can provide a type of communication tool that offers a way to help reduce the isolation of teachers and students in classrooms (Riel, 1990). Telecommunication networks often can be effective in breaking down boundaries between academic subjects and students can become critics of each other's work (Brienne & Goldman, 1989). Electronic networks, therefore, break down barriers and the remoteness that exists in schools and encourage teamwork and collaborative inquiry (Levin and Thurston, 1996).

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Electronic networks do require support, training, equipment, and time for setup. The integration of all partners as collaborators in an educational community of practice are key to its success (Ruopp, Pfister, Drayton, & Gal, 1993). Careful planning is required if the electronic communication is going to be an effective form of group interaction. Questions about the group structure need to be answered such as:

- What is the group size?
- What are the common interests of the group members?
- What are their prior experiences?
- Is there a clear group goal that includes a timeline of beginning and ending dates?
- Is there an end product?
- How will the communication take place?
- Will messages be sent individually or collaboratively?

Ruopp, et al. (1993) found that addressing these initial questions supports and strengthens the connections among the teachers and their community of practice, which included students and university researchers. In addition, they found that it was critical for someone to take responsibility for facilitating the interactions. Riel and Levin (1990) found that successful student networking projects were managed by a network coordinator and were "planned for success." In the Riel and Levin study, participants were organized into work groups that had cooperative tasks with response obligations. The network coordinator not only facilitated interactions but also evaluated the classroom interactions. Interactions were assessed using the criteria of organization of group, organization of task, response opportunities, response obligations, and evaluation of the exchanges. The study found that successful networks were those that were organized into groups rather than one to one communication, had a timeline and end product for each task, worked on the project at school, had a short response time (at least every 2 weeks) and had a coordinator that continually evaluated the success of the network. Therefore, careful organization and planning as well as continual evaluation of electronic networks have been found by researchers to be key to their success.

There are many examples of successful electronic science networks. In the LabNet project, students calculated the Earth's circumference using Eratosthenes' method. Data were collected by measuring to the nearest centimeter the shadow cast by a meter stick at high noon (Ruopp et al., 1993). Students shared this data, along with their precise latitude and longitude location, with each other. Other LabNet projects include designing a paper-and-tape structure that slows the descent of a ping-pong or golf ball or building model cars to strict performance specifications. The LabNet project verified that any science problem could be approached using a larger community of learners as long as factors vary naturally from location to location.

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Electronic networks also initiate the formation of tele-apprenticeships, as students work jointly to tackle problems with other students, teachers, adults, and scientists. An example of this type of project is one in which students shared information and collaborated on how the problem of water shortage could be solved in their communities (Levin, Riel, Miyake, & Cohen, 1987). Local data gathering, data sharing, and a comparison of other's approaches to one's own problem were all a part of the project. Results showed that students benefited by working with other people grappling with an authentic, complex problem and that in this context, they learned a great deal about water. Levin (1987) concluded, from this study, that these types of "tele-apprenticeships" should become the dominant form of instruction in education because students acquired science concepts in an instructional setting that provide dynamic support for the acquisition of problem solving skills (Levin et al., 1987, p. 258).

Other examples of collaborative electronic environmental projects include posting rainfall pH across the US, analyzing ground water samples, ranking environmental problems in your area, and tracking migratory birds (Valauskas, 1993). The STEPS Physics program focused on collaborative projects such as acid rain, collaborative physics problems and computer-based lab experiments (Lehman, J., Campbell, Halla, & Lehman, C., 1992). An example of an elementary program, the Earth Lab Project, included a "Think Tank Trivia", pre-lab hypothesis, science logs, and data gathering and sharing (Brienne & Goldman, 1990). Students investigated topics such as hurricanes and how weather affects people's lives, plate tectonics and other Earth Science topics. Brienne and Goldman (1990) found that electronic communication provided students with numerous opportunities to communicate about science and students were exposed to many new opinions. The Technical Educational Research Center (TERC; http://www.terc.edu) has developed many telecommunication projects including Feederwatch by Cornell University (http://www.birdsource.org) and KidsNet by National Geographic (http://www.kidsnet.org). Other successful ongoing science telecommunication projects include GLOBE (http://www.globe.gov), the KanCRN Collaborative Research Network (http://www.kancrn.org), and EstuaryLIVE (http://www.ncnerr.org).

Technical Educational Research Center

Feederwatch

KidsNet

GLOBE

KanCRN Collaborative Research Network

EstuaryLIVE

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Electronic networks have the potential to offer students and teachers the opportunity for authentic learning. These networks encourage teamwork, collaborative inquiry, and facilitate instruction (Levin & Thurston, 1996). Riel (1990) found that teachers shift classroom instruction from whole group instruction to small group investigations or team projects when using electronic networks. Networks make it possible to create highly interactive groups of students and teachers that otherwise would be isolated from each other.

Therefore, research indicates that electronic networks are one possible way to enhance science learning and effectively teach students to be scientifically and technologically informed. Yet, at the same time, it is clear that network-based activities are not always appropriate. The challenge to education on the electronic frontier is to identify the techniques that are most efficient and effective (Levin et al., 1989).

For some additional information on electronic networks, explore these links:

Use of Electronic Networks in Educational Settings
(http://www.ed.uiuc.edu/people/taku/unpublished.html)

Teaching Teleapprenticeships
(http://lrs.ed.uiuc.edu/TTA/Papers/TTAS.html)

Cooperative Learning Through Telecommunications
(http://www-cscl95.indiana.edu/cscl95/outlook/14_Riel.html)

Educational Electronic Networks: A review of research and development
(http://www.ed.uiuc.edu/projects/tta/papers/Levin-Thurston-96.html)

About the Author

Rita Hagevik received a BS in Biology from Meredith College and an MS in Science Education from North Carolina State University, Teacher Certification in grades K-12, with a specialization in science. Additional certifications include Academically Gifted, National Mentorship training, and North Carolina Environmental Educator. Currently, she is working at North Carolina State University as a Coach 2 Coach Teacher in which she is a liaison between the University and schools. She is also a Ph.D. student in Science Education and Forestry at NC State University. Rita worked for Wake County Public Schools for 9 years and has taught 2nd grade, 6th grade, and 8th grade. She has sponsored many students in national and state competitions and has had six national Duracell contest winners and numerous state science fair and science academy winners. Rita is a national trainer for Foundational Approaches in Science Teaching (FAST III), in critical thinking for the National Center for Teaching Thinking, in Clinical Supervision and Mentoring, and for ESRI in Geographic Information Systems.

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