Technology has changed current education in many ways. For example, computer-mediated-communication among students, teachers, and scientists has provided alternatives to traditional discourse patterns. Even though more and more telecommunication tools and projects are being introduced in the classroom, our understanding of their value and the effect is presently limited. For example, studies on how electronic discourse is different or similar to traditional classroom discourse and what features of electronic discourse are necessary to serve as a better learning environment are needed. To this end, this paper illustrates on-going efforts of an innovative science program called "Kids as Global Scientists" to take full advantage of Internet technology for better learning and teaching. We analyzed electronic communication between students and scientists on the Message Board and the development of students' scientific understanding through electronic communications. Our research shows that the Internet has great potential to foster the development of students' scientific understanding, which is difficult to achieve through traditional instruction alone. Despite increasing interest in the use of the Internet in the classroom, research on the educational benefits of the Internet on learning and teaching are still limited. This study will serve in this continuing research base in order to help expand our understanding by opening a discussion around the following questions: What are the characteristics of new learning opportunities and interaction patterns that students experienced? What new classroom dynamics and challenges are introduced as a result of the use of our technological innovations?

**Promoting Scientific Understanding through Electronic Discourse**

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This paper illustrates the on-going efforts of an innovative science program called "Kids as Global Scientists" to take full advantage of Internet technology for better learning and teaching. We analyzed electronic communication between students and scientists on the Message Board and the development of students' scientific understanding through electronic communications. Our research shows that the Internet has great potential to foster the development of students' scientific understanding, which is difficult to achieve through traditional instruction alone. Despite increasing interest in the use of the Internet in the classroom, research on the educational benefits of the Internet on learning and teaching are still limited. This study will serve in this continuing research base in order to help expand our understanding by opening a discussion around the following questions: What are the characteristics of new learning opportunities and interaction patterns that students experienced? What new classroom dynamics and challenges are introduced as a result of the use of our technological innovations?

**Introduction**

Technology has changed current education in many ways. For example, computer-mediated-communication among students, teachers, and scientists has provided alternatives to traditional discourse patterns. Even though more and more telecommunication tools and projects are being introduced in the classroom, our understanding of their value and the effect is presently limited. For example, studies on how electronic discourse is different or similar to traditional classroom discourse and what features of electronic discourse are necessary to serve as a better learning environment are needed. To this end, this paper illustrates on-going efforts of a technology-rich science program called "Kids as Global Scientists" to take full advantage of emerging technology for better learning and teaching practice. "Kids as Global Scientists" (KGS) provides over 10,000 students from all over the world with an opportunity to communicate with on-line scientists and their peers while they study natural weather phenomena using both scientific data and first-hand experiences of participants. Through various scientific inquiry processes (i.e., collecting and analyzing data, synthesizing and communicating ideas), participation of the on-line scientists, and appreciation of first-hand experiences, KGS students are encouraged to engage in sustained and productive discussions on the Message Board. In this paper we analyze on-line communication between students and scientists that took place on the Message Board and the development of students' scientific understanding through such electronic communication. In particular, this paper attempts to answer the following three questions:

1. What are the characteristics of new learning opportunities that students experienced as a result of the use of our technological innovations?
2. How does our technological innovation alter patterns of interaction between teachers and/or students in the classroom?
3. What new classroom dynamics and challenges are introduced as a result of the use of our technological innovations?
To answer the above questions we analyzed electronic messages on the Message Board and excerpts from interviews with teachers and on-line scientists.

**Scientific Discourse and Scientific Understanding**

The scientific community shares its own ways of communication and special language among its members (Dunbar, 1990; Lemke, 1990; Pera, 1994; Rosebery, Warren, & Conant, 1992). Learning science means that students can communicate with each other and with other scientific community members using the socially shared language of science (Lemke, 1990). Many studies of science education specifically stress the roles of scientific discourse to promote students' scientific understanding. For example, Kuhn (1993) addressed the importance of constructing argument as an important process of science. Bell (1997) developed an argument representation tool to promote students' science learning in the Knowledge Integration Environment. In their discourse study, Richmond and Striley (1996) argued that "science learning is a result of the ways scientific ideas are introduced, debated, and accepted or rejected as the results of interactions students have with one another as well as with their teacher" (p. 840). Therefore, the study of the role of discourse in the science classroom must not overlook the special nature of scientific discourse practice, and the science classroom should ideally be the place where this scientific discourse is being practiced by students and teachers.

**Electronic Discourse and Scientific Understanding**

Current developments in technology, in particular computer-mediated electronic discourse tools, provide new learning opportunities to foster the development of student learning through discourse. For example, **Computer-Supported Intentional Learning Environments (CSILE)** is a networked communal database designed to support intentional learning and knowledge building (Scardamalia & Bereiter, 1991; 1994; Scardamalia, Bereiter, Brett, Burtis, Calhoun, & Smith Lea, 1992; Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989). CSILE allows learners to enter various forms of information (e.g., text, drawings, graphs, timelines), and retrieve, link, rate, and comment on information in the database.

In addition, productive discourse should encourage students to not only display or represent current understanding but also offer new information, suggestions, and criticism resulting in the advancement of knowledge, or progressive discourse (Scardamalia & Bereiter, 1993; 1994). In CSILE, students are encouraged to improve their initial conjectures by revisiting their previous notes, and reviewing other students' notes and comments. Asynchronicity and communality of electronic discourse also contribute to the sustainable, revisitable, and the retrievable nature of the discourse in CSILE.

While CSILE was originally developed to support collective knowledge building in one classroom or in one school, others were interested in building an electronic community over the Internet. Riel and Levin (1990) examined critical features of successful networking learning environments as well as failures in designing electronic communities. They proposed a set of guidelines for using telecommunication as a tool for creating global learning communities. The guidelines for the construction of electronic communities include 1) a diverse group organization that ensures efficient group interaction; 2) a goal or task that is shared by the group; and 3) response opportunities and responsibilities that facilitate the interaction.

Along the same lines Edelson and his colleagues developed an electronic notebook called the CoVis Notebook which allows students to record observations, ask questions, summarize and share results with others (Edelson, Pea, & Gomez, 1996). The goal of the CoVis Notebook was to provide students with opportunities of practicing authentic science and scientific inquiry as real scientists use a notebook to record procedures or data and summarize their findings.

Hsi and Hoadley (1997) developed an electronic discussion environment called Multimedia Forum Kiosk and showed how electronic discussion tools could promote gender equity in scientific discussion participation. In their study, girls reported that they preferred electronic discussion because it offered anonymity, less interruption, and more time for reflection than class discussion. Thus, it seems to be critical to provide a learning environment where girls as well as boys feel comfortable to present their ideas without feeling judged by a teacher or other classmates.

The traditional classroom structure tends to have a limited capacity to support progressive discourse and collective knowledge building, but new technology offers the promise of supporting new forms of discourse that has