Technology Driven Group Investigations for Gifted Elementary Students

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The purpose of this study is to examine an instructional design for teaching science to gifted elementary students that integrates a gifted education teaching model (Group Investigations) with Internet-based communications, in order to conduct an onsite/outdoor learning expedition. This study demonstrates the importance of high-powered science curriculum (aligned in accordance with national science standards) and the use of advanced technologies in creating differentiated curricula for young gifted students. Given the paucity of research studies on gifted learners in science and technology, this study assessed gifted elementary students’ ability to use advanced technologies, and the worthiness of using Group Investigations (initially designed as a pedagogical model for secondary students) to conduct science expeditions. A questionnaire (Likert scales and open-ended items) was constructed to assess the extent to which students found this science project, entitled Our Lake Online, to be engaging and effective. The study strongly suggests that integration of the Group Investigations Model with advanced science content and digital technologies contribute positively to planning science programs for gifted elementary students. The research findings indicate that young gifted learners are capable of engaging in onsite science expeditions as well as highly capable of using mobile digital communications and environmental analysis tools.
BACKGROUND TO THIS STUDY

Special education for the gifted is rooted in the idea that gifted learners present demands on the school for which the institution is ill prepared (Coleman & Cross, 2001). Therefore, for the past two decades, there have been major efforts to expand opportunities for gifted learners outside the confines of traditional schooling. The research literature reveals these efforts have largely been directed toward four types of experiences that include, (a) university-based programs, (b) specialized schools both private and public, (c) homeschooling, and (d) technology-based options (VanTassel-Baska, 1998). The technology-based options have employed technology as a delivery system for high-powered curriculum such as Stanford University’s Education Program for Gifted Youth (EPGY), an Internet-based accelerated program in mathematics and physics, as well as innovative uses of technology for developing programs and projects for gifted learners.

This study examines an innovative attempt to use advanced technologies with elementary gifted children (fourth, fifth, and sixth graders) to conduct a “digital” expedition to the Lake Erie shoreline. Technologies used by the children included: laptop computers, palm-held computers, digital cameras, micro projectors, and water quality sensors. Students conducted Internet searches, engaged in telementoring experiences, developed PowerPoint presentations, and also created a web record of their onsite science discoveries [http://www.digitalexplorers.tzo.com/erie/default.htm].

Theoretical Framework and Rationale for the Project

The gifted education-teaching model used to design Our Lake Online project was the Group Investigations Model (Sharan & Sharan, 1976). This model, which was first developed in Israel by Shlomo and Yael Sharan, is a student centered approach based on John Dewey’s (1938, 1943/1902) philosophy that active experience, inquiry in a social setting, and reflective thinking are the tools of intellectual development (Maker & Nielson, 1995). Elements that are essential in the Group Investigations approach include that topics of investigation must be sufficiently complex that a single student cannot complete the investigation alone. Second, learning tasks require coordination of students’ viewpoints, must be explored from several perspectives, and have a variety of possible solutions. Third, students must engage in a variety of multilateral communications and active learning processes. Last, the teacher must create a learning environment that stimulates interaction, inquiry, and communication while maintaining an indirect, facilitative
style of teaching. Indeed, one major purpose of Group Investigations is that the teacher is a member of the learning community, not the primary dispenser of knowledge.

Based on the principles of this model, five workstations were set up on the Lake Erie shoreline so students could conduct group investigations about the natural environment. These workstations dealt with pollution, geology, wetland plants, microorganisms, and water quality. Rotating through these five workstations, the community of learners used digital cameras to photograph erosion control practices and wetland plants and plankton. The students magnified images of microscopic samples and digitized these images for transmission to their home schools. In addition, the children used palm-held computers and water quality sensors to gather data about the water quality of Lake Erie. They graphed water temperature readings, analyzed oxygen levels, and determined pH levels.

The activities that these gifted elementary children engaged in were not restricted by the belief that maturation must precede and direct the children’s experiences, and that learning experiences must be limited to grade-level curriculum deemed developmentally appropriate for fourth, fifth, and sixth graders. These group investigations were designed to optimize children’s learning and therefore, the activities were based on advanced high-powered science curriculum that integrated innovative technologies and required the students to work collaboratively with peers, older children, and adults. Thus, in addition to using the theoretical framework of the Group Investigations Model (Sharan & Sharan, 1976), based on John Dewey’s (1938, 1943/1902) educational philosophy, the researchers also drew upon Lev Vygotsky’s (1930, 1933, 1934) theory of social interaction and instruction to promote cognitive development.

Vygotsky and Dewey both believed that children’s learning should be an active experience and that problem solving in social settings was a necessary component of intellectual development. Vygotsky posited that “human learning presupposes a specific social nature and is part of a process by which children grow into the intellectual life of those around them” (Vygotsky, 1978, p. 89). According to Vygotsky (1978), an essential element of learning is that it awakens a variety of internal developmental processes that are able to operate only when the child is in the action of interacting with people. Additionally, Vygotsky held it was critically important for the child to interact with people who were more skilled and competent in what he called the technologies, or psychological tools, of the child’s culture (Snowman & Biehler, 2000; Tudge & Winterhoff, 1993; Rogoff, 1990). Also, according to Vygotsky’s theory, children will learn more if instructional interactions are
designed to fall within the child’s Zone of Proximal Development (ZPD) (Vygotsky & Luria, 1984). The ZPD refers to the difference between what a child can do on his own versus what can be accomplished with assistance, from a peer or adult, who is more intellectually advanced than he is (Vygotsky, 1986). Vygotsky suggested that educators should provide instructional activities aimed at this higher level, beyond what children could do on their own.

For gifted children, this is an especially important concept, because bright children move through conceptual and skill learning far more quickly than average learners do (Clark, 2002). Working with gifted children’s ZPD enables gifted learners to progress at their own rapid rate of learning. Therefore, Our Lake Online Project was intentionally designed to create a ZPD for elementary gifted children and to provide the scaffolding necessary to help students succeed.

Creating this advanced level or ZPD required the following key components. First, Our Lake Online Project required that students’ group investigations were conducted onsite/outdoors in addition to the learning environments (classrooms, computer labs, library) of the school. Second, environmental experts served as telementors to students prior to the onsite expedition and as workstation presenters on the Lake Erie shoreline. Several adult chaperones and young adult assistants accompanied the children as they rotated through the workstations. Professional teachers, university professors, librarians, and technology instructors facilitated the children’s learning throughout the entire scope of the group investigations and ensured the delivery of high-powered science curriculum. Advanced educational technologies as a delivery system for the rigorous curriculum, were integrated to move students beyond classroom-chalkboard instruction to onsite-online learning.

As investigations ensued, several layers of “technology scaffolding” emerged within the community of learners, in order to suspend the students within their ZPD. Educational technologies were used to empower elementary children to expand their range of science learning. The educational technologies actually became “electronic experts” to support the skills and strategies of these gifted elementary investigators. Also, the educational technologies were the very tools that linked these elementary student learners to more knowledgeable peers and experts, thus establishing master-novice apprenticeships and solid scaffolds of support for the students’ learning (Snowman & Biehler, 2000).
PURPOSE OF THE STUDY

Given the paucity of research studies on elementary gifted learners in science and technology, the researchers wanted to assess students’ perceptions and self-ratings regarding their abilities to use advanced technologies and engage in onsite science group investigations. Moreover, the researchers were interested in assessing implementation issues and to what degree differentiation had been achieved. For purposes of this study, the term differentiation is used to describe the modifications related to content, processes, and products to provide appropriate learning experiences for gifted children.

Sample

The sample was comprised of 24 gifted elementary students (fourth, fifth, and sixth graders) from four elementary and two middle schools that were part of one suburban school district located in northeastern Ohio. Gifted students were defined as those identified by the school district according to ability, achievement, and performance criteria specified by the State of Ohio, Department of Education. Grade levels were specified to ascertain any differences within the student sample.

Instrumentation

A student questionnaire was constructed that identified five workstations at which students completed tasks, and the educational technologies used to complete group investigations. Using a 5 point Likert scale, students were asked to rate their performance at the five workstations (pollution, geology, wetland plants, microorganisms, and water quality). Students were also asked to rate their ability to use the digital technologies (Macintosh and IBM laptop computers, palm-held computers, digital cameras, micro projectors, and water quality sensors). In addition, students supplied self-report data regarding the development of Internet skills and learning skills. Open-ended questions posed included: (a) What did you like best about being an investigator for Our Lake Online Project? (b) What suggestions could you make to improve this experience? (c) What are the advantages of studying and learning on location?
Procedure

Two weeks following the digital expedition to Lake Erie, the teacher of
gifted services administered a student questionnaire to all gifted students.
The students completed this questionnaire at a joint meeting attended by the
students’ teachers and parents that was held after the school day dismissal.
A university professor from northeastern Ohio attended this meeting and ex-
plained issues of confidentiality and anonymity to the gifted learners. Addi-
tionally, parents and teachers involved with Our Lake Online project also
completed separate questionnaires, administered by the university professor,
about the project and expedition in an adjacent classroom.

The expedition to Lake Erie was the capstone experience for this five-
month study. The Our Lake Online project was designed to accommodate
gifted learners needs for a differentiated curriculum. This differentiation in-
cluded advanced science content, research skills, technology skills, indepen-
dent inquiry skills, and group investigations. The Our Lake Online project
focused on educational standards cited in the National Research Council
(1996) science standards which include: learner outcomes of significance;
emphasis on scientific process; emphasis on experimental design; emphasis
on scientific habits of mind; investigation of real interdisciplinary problems;
integration of science and technology; and, the use of collaborative learning
and hands-on activities.

Results and Discussion

The students’ ability to complete multilevel learning tasks at all five
workstations was hampered due to a severe thunderstorm in the afternoon on
the day of the expedition. However, all workstations (pollution, geology,
wetland plants, microorganisms, and water quality) were used by some of
the children. Based on a five point Likert scale (1 = poor, 2 = okay, 3 =
good, 4 = very good, 5 = great), 71% of students rated their overall ability to
complete tasks at work stations as very good, and 20% of students rated
their ability as great. The favorite work station choice indicated by fourth
graders was a tie between pollution and microorganisms; 67% of fifth grad-
ers indicated microorganisms; and 50% of sixth graders indicated geology.

The water quality workstation was least favored (13%) and researchers
determined this was so because the students had not received prior training
with the palm-held computers or water sensor equipment. A Midwestern
university provided this equipment for the day of expedition. Representa-
tives from this Midwestern University were onsite at the water quality station
to demonstrate the use of the equipment and assist the students. Procedures at the water quality workstation, with students who did engage in tasks before the thunderstorm, ran smoothly enough that the expedition lead teacher decided to purchase palm-held water sensor equipment for future expeditions.

**Student Usage of Digital Technologies and Environmental Analysis Tools**

The student usage of digital technologies and environmental analysis tools are presented in Table 1. The 100% usage rate for the digital camera can be accounted by the fact that each of the five group investigation teams had at least one digital camera to use at all times. There were three additional digital cameras available for use by students when needed. Prior to the expedition, students were taught the skills needed to successfully transfer text and digital image information from either the IBM or Macintosh platform. The smaller percentage of students who used Macintosh laptops is related to the fact that computer labs at the fifth and sixth graders schools are exclusively IBM; whereas, computer labs at the fourth graders schools are exclusively Macintosh.

![Table 1](image)

**Student Ratings of Ability to Use Technology Tools**

Student questionnaire ratings for Likert-scale items that analyzed students’ ability to use technology tools at the five workstations are presented in Table 2. All fourth, fifth, and sixth grade students completed two days of prior training at a county career and technical center to learn how to use the technology (with the exception of palm-held computers and water sensor
equipment). On the first training day, students learned about the operation and features of the digital camera and the use of photo editing computer software. Students practiced these skills by venturing outdoors on the technical center school grounds and taking digital photographs of the school’s natural setting. The students then downloaded these images to desktop computers and sent them as email attachments to their home schools. Technical education teachers also shared design possibilities for students to use to compose web pages, storyboards and photo editing to create records about their Lake Erie experience. The second workshop afforded students the opportunity to use microscopes, micro projectors, and Elmo visual presenters to magnify and project samples from pond water found at the county career and technical school site. Once again, students practiced these skills. During these two days of training, the elementary students were provided with a great deal of individual attention given the help and guidance of the technical education teachers and 29 technical education high school student assistants.

### Table 2
Student Ratings of Ability to Use Technology Tools

<table>
<thead>
<tr>
<th>Technology Tool</th>
<th>Fourth Grade Rating</th>
<th>Fifth Grade Rating</th>
<th>Sixth Grade Rating</th>
<th>Sample Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Use of Digital Camera</td>
<td>3.5</td>
<td>4.0</td>
<td>4.4</td>
<td>4.0</td>
</tr>
<tr>
<td>Digital Photos of Erosion Control Practices</td>
<td>3.3</td>
<td>3.8</td>
<td>4.4</td>
<td>3.8</td>
</tr>
<tr>
<td>Palm-held Computers Usage</td>
<td>2.8</td>
<td>3.7</td>
<td>3.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Digital Photos of Wetland Plants</td>
<td>3.0</td>
<td>3.3</td>
<td>4.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Use of Laptop to Preview Digital Photos</td>
<td>3.1</td>
<td>4.0</td>
<td>4.4</td>
<td>3.8</td>
</tr>
<tr>
<td>Use of Laptop to Email Data</td>
<td>2.6</td>
<td>3.4</td>
<td>3.7</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Note. Student judgments were made on 5-point Likert scales (1 = Poor, 2 = Okay, 3 = Good, 4 = Very Good, 5 = Great).
Mean scores for the students’ ability to use technology tools are reported in Table 2. Mean percentages for the students’ use of technologies and environmental analysis tools are presented in Table 1. Students gave the highest usage percentages and ratings for technology tools (lap top computers, digital camera, microscope, and micro projector) that they had been previously trained to use before the expedition. However, the students’ mean ratings, regarding their ability to use all of the technology tools, were good or very good. Generally, the data in Table 2 indicates progressively higher student ratings for the advanced grade levels. It should be noted that students were heterogeneously grouped by grade level to complete learning tasks at all five workstations. The researchers recommend that this organizational framework is best given the older students’ ability to support the novice technology abilities of the younger students. In response to the open-ended question that asked students what they liked best about being an investigator for Our Lake Online Project, over three fourths of the students cited the use of technology. Some student statements included: “You could use digital tools and I had a good time exploring;” “I liked the technology;” and “I liked being able to gather my own data with the technology.”

Student Ratings of Ability to Perform Hands-On Learning Tasks

Table 3 reports the students’ ratings about their ability to perform hands-on learning tasks at the workstations. Mean scores for the students’ ability to perform tasks ranged from 3.6 to 4.2; thus, indicating ratings of good and very good. Once again, the data in Table 3, as well as the data reported in Table 2, indicates progressively higher student ratings for the advanced grade levels. It should be noted that these hands-on tasks were intentionally designed according to the principles of the Group Investigations Model (Sharan & Sharan, 1992) to be sufficiently complex that a single student could not complete the investigation alone. The tasks at the Lake Erie shoreline enabled student experimentation and discovery, active inquiry, and problem solving. In response to the open-ended question that asked students what they liked best about studying and learning on location, the students overwhelmingly noted the opportunity for hands-on experiences, and the opportunity to see things in real life. Fourth graders noted: “You can see things for yourself and understand more clearly;” “We got to see everything that the teachers did instead of reading it in a book;” and, “You get to first hand experience it.” Fifth graders reported: “It just isn’t the same reading about it. It allows you to go to a whole new level of learning;” “Everything is in an
arm’s reach;” and, “You can learn more because you are able to see what they are talking about.” Sixth graders stated: “You learn more about the planet;” “You get to actually experience it and see the lake first hand;” and, “It is more exciting and risk-taking than sitting at a desk with a book in front of your face.” The students’ responses certainly attest to the importance of active learning espoused by John Dewey and Lev Vygotsky.

### Table 3
Student Ratings of Ability to Perform Hands-On Learning Tasks

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Fourth Grade Rating</th>
<th>Fifth Grade Rating</th>
<th>Sixth Grade Rating</th>
<th>Sample Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collection</td>
<td>3.6</td>
<td>3.6</td>
<td>4.3</td>
<td>3.8</td>
</tr>
<tr>
<td>Collection of Rock Samples</td>
<td>3.8</td>
<td>3.3</td>
<td>4.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Capture Plankton</td>
<td>3.9</td>
<td>4.0</td>
<td>4.6</td>
<td>4.2</td>
</tr>
<tr>
<td>Conduct Lake Dip</td>
<td>3.0</td>
<td>3.3</td>
<td>4.6</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Note. Student judgments were made on 5-point Likert scales (1 = Poor, 2 = Okay, 3 = Good, 4 = Very Good, 5 = Great).*

### Students Requests for Assistance to Conduct Group Investigations

For students to develop the independence necessary to conduct group investigations, teacher leadership must be indirect and flexible. This model requires the teacher to be a facilitator, a consultant, and a guide. Educators involved with the Group Investigations Model must be highly skilled professionals; however, they too, are members of the learning community. This change is necessary for students to assume the roles of active learners, problem solvers, and decision-makers. Indeed, it is difficult for many educators to make this paradigm shift and free students to investigate. Breaking the traditional mold that requires teachers to assume direct control does not mean that students are free to do whatever they want. Relinquishing the traditional teacher control requires extraordinary efforts. Educators must carefully create an overall plan, identify numerous resource persons and materials, develop multifaceted learning activities, and organize learning groups. Educators must provide several prior opportunities for students to develop complex skills for working together as a community, and arrange for a learning environment that supports active inquiry. Often this requires breaking out of the confines of the classroom walls and establishing a learning environment onsite. Sharan (1990) boldly argued that group investigations can
be implemented only to the extent that traditional whole-class teaching is supplanted, not just altered.

Therefore, to provide the necessary indirect assistance elementary children needed to conduct group investigations on the Lake Erie shoreline, several persons in addition to the children’s teachers provided such support. These persons included thirteen parent chaperones, seven high school assistants, two college student assistants, and five workstation presenters. The workstation presenters included: a Geneva State Park ranger, a geologist from the Ohio Department of Natural Resources Geological Survey Division, a scientist from the Ohio Department of Natural Resources Wildlife Division, a water quality technology tools expert from PASCO Scientific Corporation, and an environmental workshop facilitator from Indiana University. Please note that the five workstations set up on the shoreline were approximately three to four football field length distances from one another. Base camp consisted of two tents and a recreational vehicle that also needed to be supervised. In addition, travel one way to Lake Erie was a 1.5-hour bus trip. Thus, the reader can appreciate the need for several adults and young adult assistants to provide expertise, guidance, and assistance for young elementary children engaged in onsite learning expeditions. Scientific inquiry conducted onsite makes the occasion ripe for children’s ZPD to emerge!

The students’ requests for assistance are presented in Table 4. The sample mean percentages indicate that over half of the children requested assistance from teachers (59%) and adult chaperones (54%). As expected, the younger children required greater assistance. Sixty-three percent (63%) of fourth graders requested assistance from teachers and adult chaperones as compared with 56% of fifth graders requests for assistance from teachers and adult chaperones. Fifty-seven percent (57%) of sixth graders requested assistance from teachers, and 43% of sixth graders requested assistance from adult chaperones. These percentages underscore Vygotsky’s theory that children’s cognitive development is strongly influenced by those more intellectually advanced.

Indeed, the Group Investigations Model does provide the content, process, product, and learning environment modifications recommended for gifted learners. However, use of this model with elementary gifted children does require the availability and assistance of many mentors as indicated by Table 4 data. Maker and Nielson (1995) suggested that the availability of mentors might be a problem in many school districts. Although this problem was circumvented by organizing the efforts of so many adults for Our Lake Online project, the researchers recognized that implementation of this project would have been impossible without such support.
Table 4
Student Requests for Assistance to Conduct Group Investigations

<table>
<thead>
<tr>
<th>Assistant</th>
<th>Fourth Grade Requests</th>
<th>Fifth Grade Requests</th>
<th>Sixth Grade Requests</th>
<th>Sample Mean Requests</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School &amp; College Student</td>
<td>38%</td>
<td>44%</td>
<td>29%</td>
<td>37%</td>
</tr>
<tr>
<td>Workstation Presenter</td>
<td>38%</td>
<td>44%</td>
<td>0%</td>
<td>27%</td>
</tr>
<tr>
<td>Adult Chaperone</td>
<td>63%</td>
<td>56%</td>
<td>43%</td>
<td>54%</td>
</tr>
<tr>
<td>Teacher</td>
<td>63%</td>
<td>56%</td>
<td>57%</td>
<td>59%</td>
</tr>
</tbody>
</table>

Student Ratings of Internet Skill Development

There are many ways to link educational technologies with the theories of Vygotsky. For example, students can use the computer as an “expert peer or collaborative partner to support skills and strategies that can be internalized by the learner,” and also use the World Wide Web (WWW or Web) as a communication link to more “knowledgeable peers and experts, who establish a master-novice apprenticeship and scaffold their learning.” (Snowman & Biehler, 2000, p. 57).

Students’ use of the WWW prior to the expedition included Internet searches and the examination of established science URL sites related to the topics of ecological vulnerability and sustainability of the Great Lakes, and specifically Lake Erie. Based on science classroom instruction and initial Internet use, the fifth and sixth grade gifted learners selected independent study topics to research and develop reports and presentations. The fifth and sixth graders were given guidelines for individual research projects that included student reading logs and completing all necessary steps of the research process. Regarding class presentations, students were required to deliver oral reports, and develop a visual aid related to their topic. The fourth grade gifted learners assignment did not involve independent research projects. The educators believed that it was more developmentally appropriate to engage fourth graders in mini lessons and guided web searches regarding topics such as microorganisms, aquatic life, water quality, shoreline erosion, and wetland plants and plankton. These mini lessons were taught by teachers of gifted educational services, and provided the foundational learning that fourth graders would need to successfully accomplish onsite tasks at Lake Erie. Fourth grade students, however, were required to make oral presentations about these mini lesson topics to regular fourth grade classrooms.
The students’ creative uses of the computer and Internet included the development of *PowerPoint* presentations, brochures about Lake Erie, classroom ecology posters, and expedition study guides. The students were taught how to use the software programs, *Adobe PhotoShop*, and *Microsoft Photo Editor*, for photo manipulation and editing, thumbnail story boarding, and to design their own project planners. For analysis and planning, the students were taught to use the *Microsoft Excel Spreadsheet Program*. The students used *Excel* for data entry, graphing, and charting purposes. Students also made presentations, with teacher assistance, on an Elmo visual presenter interfaced with a television monitor. Another analysis tool used by the children was a micro projector. Students were able to locate microscopic organisms on a slide that was mounted on a micro projector. The micro projector enabled the students to magnify and project the specimens they collected and also enabled students to capture these images digitally with a camera.

The students’ research abilities were empowered by the use of the Internet’s two major functions—its library with features that cannot be duplicated by any other means, and its means of communication (Bennett, 1999). The independent study topics investigated by means of the Internet’s variety of sources included: “The Effects of the Eurasian Watermilfoil and Purple Loosestrife Plants on Lake Erie,” “Sea Lamprey: An Invader Species,” and “The Spiny Water Flea.” The fifth and sixth grade students also engaged in telementoring experiences with science experts throughout Ohio. E-mail exchanges between the students and mentors were made on a weekly basis for approximately two months. The fifth and sixth gifted learners made research presentations to students in the regular classrooms and to graduate students at the local university.

The students’ ratings for development of Internet skills largely reflect the degree to which students became involved with independent study projects. That is, the fourth grade students use of the Internet was limited to guided web searches and visits to established science URL sites to engage in mini-lessons. Therefore, the fourth graders rated their development of Internet skills as simply “okay” in three areas, and “good” for the use of the Internet as related to research skill development. It was fifth and sixth grade students who acquired mentors and dialogued by way of e-mail for gathering information, in addition to conducting more in-depth searches on the WWW to investigate independent study topics. In contrast, the sixth graders rated all areas of Internet skill development as “very good.” Therefore, ratings by fifth and sixth grade students who conducted more complex research using the Internet are higher than fourth grade children as can be seen in Table 5.
Table 5
Student Ratings of Internet Skill Development

<table>
<thead>
<tr>
<th>Internet Skill</th>
<th>Fourth Grade Rating</th>
<th>Fifth Grade Rating</th>
<th>Sixth Grade Rating</th>
<th>Sample Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWW</td>
<td>2.1</td>
<td>3.7</td>
<td>4.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Creative Uses</td>
<td>2.7</td>
<td>3.7</td>
<td>4.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Analysis &amp; Planning</td>
<td>2.9</td>
<td>3.7</td>
<td>4.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Research Skills</td>
<td>3.0</td>
<td>3.8</td>
<td>4.0</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Note. Student judgments were made on 5-point Likert scales (1 = Poor, 2 = Okay, 3 = Good, 4 = Very Good, 5 = Great).

Student Ratings of Learning Skills Development

The ratings in Table 6 clearly indicate that the skills required for collaboration reported by the sample mean were the highest developed skills, with all other learning skills ranking close behind. The fourth graders’ rating of 4.7 regarding collaboration clearly attests to the power of the Group Investigation Model to facilitate peer collaboration. Researchers have emphasized the importance of collaboration with peers (Damon, 1984; Doise & Mugny, 1984). In addition, researchers have noted the importance of providing children of similar abilities the opportunity to work together because these students make greater gains in conceptual development than do children in whole class instruction (Phelps & Damon, 1989). Consider that by grades five and six, the middle school environment warrants growth in the structure of student communication and collaboration. The fifth and sixth grade students had been previously exposed to greater opportunities with group learning as compared to what typically takes place at the fourth grade elementary school level. The Group Investigations Model required the students to work collaboratively to provide academic, technological, and peer support for one another. This included being part of a group investigative team to conduct an onsite science expedition, making presentations at the schools and university, and constructing a web record of their discoveries. Therefore, when students processed science content into product they met performance expectations by working together as a community of learners.
Table 6
Student Ratings of Learning Skill Development

<table>
<thead>
<tr>
<th>Learning Skill</th>
<th>Fourth Grade Rating</th>
<th>Fifth Grade Rating</th>
<th>Sixth Grade Rating</th>
<th>Sample Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>4.2</td>
<td>3.5</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Collaboration</td>
<td>4.7</td>
<td>3.9</td>
<td>3.8</td>
<td>4.1</td>
</tr>
<tr>
<td>Self-Management</td>
<td>3.9</td>
<td>3.9</td>
<td>4.3</td>
<td>3.8</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>3.4</td>
<td>4.0</td>
<td>4.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Presentation Skills</td>
<td>3.6</td>
<td>3.6</td>
<td>4.4</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Note. Student judgments were made on 5-point Likert scales (1 = Poor, 2 = Okay, 3 = Good, 4 = Very Good, 5 = Great).

Student Frustrations with the Online—Onsite Group Investigation

Table 7 reveals that the most vexing frustration the students faced was the difficulty accepting technology failures that occurred the day of the expedition. The primary technology failure centered on connectivity problems. Although four temporary phone lines had been connected to enable transmission of e-mail attachments and photographs to the respective home schools, there were many digital transmission problems. At times, the students also experienced difficulty when crossing hardware platforms. The fifth and sixth graders experienced greater frustration than fourth graders because they better understood why these procedures should work, and they had previously engaged in more simulations when the technology worked smoothly. The researchers also believe that the older students were more frustrated given the peer pressure they felt when they realized their classmates at the home schools were waiting to receive the digital transmissions. In response to the open-ended question that asked students to make suggestions to improve this expedition, many students made suggestions related to technology. For example, a fourth grade student stated, “We need more computers, bigger tents, and less stuff to do.” A fifth grader’s suggestion was to, “Get the e-mail connection better, and have more time at each station.” Sixth graders suggestions included: “Have more IBM laptops, maybe more digital cameras and disks;” “Make sure the technology works before going on the expedition;” “Make the modem faster;” “The technology glitches need to go;” and “Um…Maybe make sure that everything works before we go. Such as the Mac disks, and the problem with everyone logging on line, and so on (but I am not saying that it is your fault or anything).” This was the first time the students had engaged in a digital expedition; therefore, they held high expectations that the technology tools would work...
rather than at times present real barriers. Thus, these young children did not fully realize that often technology can be a source of a spin of frustration, confusion, and irritation (Boettcher, 2000).

### Table 7

Percentage of Students Experiencing Frustrations During Online—Onsite Investigation

<table>
<thead>
<tr>
<th>Frustration</th>
<th>Fourth Grade Concern</th>
<th>Fifth Grade Concern</th>
<th>Sixth Grade Concern</th>
<th>Sample Mean Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swamped with Information</td>
<td>25%</td>
<td>44%</td>
<td>43%</td>
<td>37%</td>
</tr>
<tr>
<td>Unable to Collect Enough Data</td>
<td>29%</td>
<td>33%</td>
<td>29%</td>
<td>30%</td>
</tr>
<tr>
<td>Difficulty with Technology Glitches</td>
<td>13%</td>
<td>33%</td>
<td>43%</td>
<td>30%</td>
</tr>
<tr>
<td>Difficulty Accepting Technology Failures</td>
<td>37%</td>
<td>62%</td>
<td>71%</td>
<td>57%</td>
</tr>
</tbody>
</table>

### CONCLUSION

Maker and Nielson (1995) stated that because of its complexity, the Group Investigations Model might not be appropriate for young gifted students. They advised that prior experience in group processes, planning, decision making, and organizational skills were necessary prerequisites to engage in this approach for collaborative inquiry. Other possible disadvantages noted by Maker and Nielson (1995) included the following: the availability of resources and mentors may be a problem in many schools; the approach requires student mobility and the movement from the classroom to other sites; and, the approach requires a variety of information sources. In addition, these gifted education experts cautioned that some teachers and parents might be concerned that the Group Investigations Model discourages traditional teaching practices such as student competition and the requirement for all students to acquire the same information.

Although the researchers recognized the challenges of using the Group Investigations Model, much less attempting this approach with elementary children, the theories of Dewey and Vygotsky are venues of light that illuminate the vision of the Group Investigations Model. As advocates for gifted education the researchers believed this model was an excellent pedagogical framework to integrate with technology. The researchers recognized that today’s digital technologies were the tools gifted elementary students and
teachers could use to engage in such a complex project. Also, the researchers recognized that technology driven group investigations, which target the students’ zones of proximal development, met the criteria for the differentiation of science curriculum for gifted learners. Simply stated, the secret for the success of using the Group Investigations Model with young children was the integration of technology.

Use of the WWW empowered students to have access to a superb library and enabled these young children to learn the fundamentals of doing research. Use of the Internet and digital technologies empowered students to engage in a variety of communicative processes that were inherent to the group investigations approach and critically important for student success. Students were able to engage in telementoring experiences with university science professors. Students were able to communicate their learning to classmates by using computer software programs to create PowerPoint presentations, expedition study guides, and brochures. Students were able to gather scientific data and create a dynamic web record to post and share with fellow students and the WWW community.

Use of the Internet and digital technologies enabled the expedition lead teacher to communicate with experts throughout the United States and gain their assistance for the project. Without these tools, it would have been impossible for her to organize and coordinate the efforts of her school system, a county career and technical center, a non-profit outdoor learning organization, telecom corporations, a state park, a state department of natural resources, and several universities. Without the help and expertise of these individuals and their organizations, Our Lake Online project could not have been implemented. The Our Lake Online project exemplified Dewey’s educational philosophy that noted active experience, inquiry in a social setting, and reflective thinking are the tools of intellectual development (Maker & Nielsen, 1995). The project also highlighted Vygotsky’s theory of social interaction and instruction to promote students’ cognitive development (Snowman & Biehler, 2000).

In many ways it is paradoxical to consider digital onsite science expeditions to be cutting edge programs for gifted learners because these gifted elementary children have grown up in the digital age. These children wear digital watches, play with digital toys, and watch DVDs. Technologically inexperienced educators appear to have much more fascination as well as fear about using these advanced technologies. Indeed, today’s schooling must move beyond penmanship to keyboarding, from simple reliance on the school library to the excellent resources and libraries on the Internet, and provide more opportunities to move beyond classroom—chalkboard instruction to onsite—online learning.
The evaluation data regarding Our Lake Online project indicates that this initial endeavor was successful. The study strongly suggests that integration of the Group Investigations Model with advanced science content and digital technologies contribute positively to planning science programs for gifted elementary students. The research findings indicate that young gifted learners are capable of engaging in onsite science expeditions as well as highly capable of using mobile digital communications and environmental analysis tools.

References


