Report of STUDIO 3D Project Evaluation

Evaluation conducted by:

Boris B. Volkov
Jean A. King
Evaluation Studies Program
Department of Educational Policy and Administration
University of Minnesota

November, 2003

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Executive Summary

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I. Project Background

I find that my job is to bring out something fun but that also has lots of learning.
A Studio 3D mentor

Project Background

The STUDIO 3D program, funded by a grant from the United States Department of Education under the Community Technology Centers program, completed its third and final year. STUDIO 3D (Digital, Design, and Development) is an after-school outreach program that provided access for adolescents, ages 10-18, living in low-income, inner-city neighborhoods in Minneapolis and Saint Paul to equipment, software, and adult mentors to support them in learning and applying advanced digital design technologies. The project offered equipment, technological expertise, program resources, and an environment that allowed participating youth to learn how to use advanced applications as creative tools for interdisciplinary learning. This multi-site project was hosted at the Landfall Investigation Station and Teen Center, the Museum Magnet School's, the Youth Science Center and Playful Invention Center at the Science Museum of Minnesota, Clara Barton Open School, and ICALL School in the Lehman Center.

STUDIO 3D was initiated with three goals in mind:

- To provide opportunities for low income and at risk young people to work on creative projects using advanced computer technology;
- To encourage and nurture a positive relationship between STUDIO 3D youth participants and adult mentors in the areas of art, science, technology and engineering; and
- To provide resources and support for community centers to use computers in educationally effective ways.

Specific objectives for this multi-site project included the following:

- Access to technology for young people who would not otherwise have it;
- The development of technological skills in these young people;
- Support for participants to start a project and follow it through to completion;
- Participant satisfaction;
- The development of positive relationships among youth participants and between participants and adult staff and mentors; and
- The development in participants of an interest in learning more through continued participation in STUDIO 3D or other extracurricular activities.

Program rationale

The purpose of the program was to increase access to learning technology. Given access to sufficient resources and guidance from peers and caring adult mentors, young people could become designers and creators—not merely consumers—of computer-based projects. While it

became increasingly common for community centers in low-income Twin Cities neighborhoods to get computers for use in their after-school programs, they were used by young people, for the most part, either for games or to surf the Internet because community center staff typically lack expertise in using advanced software applications.

The project provided opportunities for children who might otherwise not have access to technology. By involving volunteer and paid mentors, the program provided youth the opportunity to see adult role models working on projects and *learning*. Mentors did not simply provide "support" or "help"; they also worked on their own projects and invited youth to join in.

Rationale for an open workshop environment and project-based programming. In recent years, a growing number of researchers and educators have argued that design projects provide rich opportunities for learning (see, e.g., Papert, 1993; Papert & Resnick, 1995; Resnick, 2001, 2002; Resnick, Berg, & Eisenberg, 2000). There are many reasons for this interest in design-based learning:

- Design activities engage youth as active participants, giving them a greater sense of control (and responsibility) over the learning process, in contrast to traditional school activities in which the goal is to "transmit" new information to the students.
- Design activities encourage creative problem-solving by avoiding the right/wrong dichotomy of most school math and science activities, suggesting instead that multiple strategies and solutions are possible.
- Design activities can facilitate personal connections to knowledge; designers develop a special sense of ownership (and caring) for the products (and ideas) that they design.
- Design activities promote a sense of audience, encouraging youth to consider how other people will use and react to the products they create.

To be successful in tomorrow's workplace, young people need to see projects through from idea to completion. The open workshop environment of STUDIO 3D provided participants with opportunities to gain experience in both working independently and in groups: making choices, taking initiative, persisting and finding alternatives when things go wrong, and being self-motivated without having everything they do determined and monitored by someone else.

Target Population

The target audience for the program was young people between the ages of 10–18 living in inner-city neighborhoods of Minneapolis and St. Paul. Special emphasis was on three groups under-represented and under-served in the sciences: girls, youth of color, and young people from economically disadvantaged circumstances.

Evaluation : Purposes, Areas of Inquiry, and Methodology

Evaluation Purposes and Primary Intended Users

The purposes of the STUDIO 3D evaluation were to collect information about the impact upon student learning as a result of participating in the STUDIO 3D Project, as well as to elicit information for program improvement. The primary intended users were the Director of the Learning Technologies, Keith Braafladt, and Project Developer Molly Reisman, who gave the evaluators collaborative feedback throughout the evaluation process.

Areas of inquiry

Recruiting and retention

- Examine effective ways of recruiting and retaining students at STUDIO 3D sites.

Impact on the project participants

- Assess the impact of participation in STUDIO 3D on students. Discover and describe the different ways in which students use the program's resources in their learning.
- Examine the impact of laptop computer use on student academic achievement. Study how accessibility to technology influences student learning, thinking, and creativity.
- Determine students' needs, concerns, and opinions about the project's technology as a facilitator of their learning.

Tracking student impact

- Find efficient ways for STUDIO 3D to record and track student impact over time in the areas of student knowledge, skills, and attitudes.

The program as a whole

- Determine which aspects of the overall program are most successful and which aspects are least successful or most problematic, and why.

Evaluation Approach

This evaluation research relied on the full cooperation of the STUDIO 3D coordinators, mentors, and youth participants. The report is based on data collected during spring and summer 2003. Qualitative (descriptive and interpretive) methods were used togather data to answer the questions posed above as well as other questions that come up during the study. A case study design was used in this research (Yin, 1994).

Despite a desire to do so, the evaluation did not use results of the participants' school achievement tests due to the insensitivity of the standard measures available in evaluating the results of innovative uses of educational technology. Standardized tests were either not informative for the classroom or they were inappropriate measures of the proper application of technology with students (Herman, 1994; McNabb, Hawkes, & Rouk, 1999; Milone, 1996; Rockman, 2000). In addition, some of the important effects of innovative technology projects may not be assessed well by standardized measures (e. g., such positive changes in students' abilities as sophisticated problem solving, collaborative learning, global awareness, independence and efficacy, and engagement and motivation, as well as in students' specific technology skills).

Data Collection Methodology

Site visits. One evaluator spent several days at the STUDIO 3D sites, observing and speaking with youth participants, their mentors, and site coordinators.
Observations. This evaluator spent hours observing youth participants doing their creative projects with the use of technology during STUDIO 3D sessions and public events.
Student survey. A written survey was administered to students participating in the project on their perceptions of the project. A three-page survey of 24 questions was used for the drop-in center, and a two-page survey of 15 questions was administered in the participating schools. (See Appendices for the survey forms.) A total of 96 students completed surveys. Findings from the participant surveys are reflected in the relevant section of this report.

Interviews. Individual interviews were conducted with the SMM staff coordinating the project. A structured list of questions was used (see Appendices for a copy of the interview protocol), and each interview lasted approximately 30-50 minutes. While on sites, in addition to brief, fact-finding talks with the staff and students, the evaluators conducted individual informal student and mentor interviews. Altogether, we conducted 14 interviews with various participants, described in greater detail in the report.

Document and literature analysis. Review was conducted of the program documents (program goals, expected outcomes, and project status updates) as well as of research and evaluation literature (on existing theories and methods of measuring attitudes and achievement in learning technology). The evaluators also analyzed written and on-line journals created by youth participants and mentors.

Table 1 illustrates how the instruments were used to address different questions. The data collection strategies and their alignment with various questions were subject to change in consultation with STUDIO 3D personnel. Samples of the tools are included in the appendices.

Table 1. Evaluation Questions and Methods

Evaluation Question	Information Needed	Evaluation Methods
1. What are effective ways of recruiting and retaining students at STUDIO 3D sites?	▪ Activities at the different sites (school-based, drop-in/off-site, on-site) ▪ Teachers' opinions about what works ▪ Student opinions about what attracts and keeps them interested	Observation One-on-one interviews with teachers, staff Student surveys (school-based and drop-in sites)
2. What impact does participation in STUDIO 3D have on students?	▪ Short-term outcomes (both "with technology" and "of technology") ▪ Longer-term impact	One-on-one interviews with teachers, staff Student surveys Compiling existing data
3. How can Studio 3-D record and track student impact over time in the following areas: ▪ Knowledge? ▪ Skills? ▪ Attitudes?	▪ Program goals and expected outcomes ▪ Existing instruments for measuring attitudes and achievement in technology ▪ Capacity of SMM to maintain information over time	Document review Literature review Interview

Analysis

An inductive approach was used to analyze the data. While specific evaluation questions have been posed to guide the research, no hypotheses were formed prior to data collection and analysis. Rather, the data guided the patterns and themes generated (Patton, 1990). Such an approach was intended to yield a rich and meaningful portrayal of this innovative project.

Literature Review

Today, technology offers new ways of teaching and learning; and provides new ways for all involved in education to be openly accountable to parents, communities, and students (Ellmore, Olson, & Smith, 1995). The National Academy of Sciences suggests that new and emerging technologies have the potential to enhance learning and the development of new knowledge in many exciting ways (Bransford, Brown, Cocking, & Bransford, 1999). Means (1997) points out that technology can add to learners' perceptions that their work is authentic and important, increase the complexity students can deal with successfully, increase motivation and self-respect, and initiate more collaboration among students.

The real promise of technology is in its potential to facilitate fundamental, qualitative changes in the nature of teaching and learning (Thompson, Schmidt, & Stewart, 2000). Technology can enable a more enriching and effective educational experience, especially for those in environments where it is used properly (Williams, 2002). Dede (2000) affirms that the fundamental issue in learning technologies is not whether they are more efficient at accomplishing current goals, but how they can provide an effective means of reaching essential educational objectives in the technology-driven evolution of a knowledge-based economy. Positive educational experiences may depend not only on whether students can access technology, but on their access to the information made available by technology and their access to educators trained to integrate technology into meaningful learning experiences. Dede (2002) suggests that the important issue in effectiveness for learning is not the sophistication of the technologies, but the ways in which their capabilities aid and motivate users.

How technology is actually used is a critical issue and many schools may be using technology in ways that may not contribute significantly to their entire population's productive learning. Utilization, in this regard, is a relative (not absolute) term, as the effectiveness of technology to enhance education depends on the ability to create educational activities to equitably meet the needs of all students – regardless of gender, race, socioeconomic level, or ability level. Becker (2000) indicates that technology becomes a valuable and well-functioning instructional tool when enough equipment is available and convenient to permit activities to flow seamlessly with other learning tasks, and when teachers' philosophies support a student-centered, constructivist pedagogy that incorporates collaborative projects partly defined by student interests. To expand technology to fully enhance learning for both genders, educators must create an environment where students are welcome and encouraged to explore, become confident, and gain expertise.

Current reform efforts in virtually every discipline promote the idea that students should be actively engaged in inquiry on a regular basis. Coulter (2000) describes how technology can

support and enhance an inquiry environment, and contends that it is not the technology per se which makes the activity valuable, but it is all in how it is implemented. There are many great inquiry projects available that can be extended considerably with the infusion of technology. By modeling a disposition toward inquiry, rewarding creative and critical thinking, and employing technology resources where they are helpful, children will have richer inquiry experiences.

Based on theoretical and research findings, Professor Urie Bronfenbrenner, the co-founder of the Head Start program, has formulated five propositions of human development. One of them is that

> *The establishment of patterns of progressive interpersonal interaction under conditions of strong mutual emotional attachment enhances the young child's responsiveness to other features of the immediate physical, social, and - in due course - symbolic environment that invite exploration, manipulation, elaboration, and imagination. Such activities, in turn, add new dimensions to the child's psychological growth.*

This proposition has important implications. Open-ended lab spaces can encourage exploration and play and therefore contribute to growth, which is further enhanced by strong and enduring relationships with adults. According to the book *Natural Wonders: A Guide to Early Childhood for Environmental Educators*, young children learn best through making discoveries for themselves. Through taking part in open-ended experiences, children can learn what they are ready to understand.

The benefits to offering a lab space with open-ended activities include the following:

- *Everyone can learn.* With open-ended activities, children can naturally tailor the activity to their interests and abilities.
- *Children are empowered to learn.* Giving children open-ended activities encourages them to pose their own questions, test their ideas, share with their peers and take part in the scientific method.
- *Learning can be more spontaneous.* With open-ended activities, the same materials can be used over and over with different learning happening each time.
- *Educators have more opportunities for catching the teachable moment.* Open-ended activities help adults take on the role of facilitator, supporting rather than dictating what and how children learn. It allows for more flexibility, experimentation and discovery (Oltman, 2002).

Resnick (2002) affirms that, in educational technology projects, participants can be exposed to technology in new ways. They are becoming *fluent* with the technology, which involves "not only knowing how to use technological tools, but also knowing how to construct things of significance of with those tools" (Resnick, 2002, p. 33).

Implementation Issues: STUDIO 3D Participants, Sites, and Activities

People served by the project

The original goal and purpose of the project was to bring programs to economically underserved communities, children from diverse racial backgrounds, and girls who are not usually directly focused on science and technology. The first STUDIO 3D audience were

children who came in, all kinds of children, successful and those lagging behind. STUDIO 3D offered them a place to go, provided them an opportunity to have relationships with adults and their peers. They could have access to technology. They could use it how they wanted to, but there were people showing them different ways that they could use it. Data suggest that when mentors came in, it was a very rewarding experience for students. It positively affected community that got these resources, families, and schools involved with this informal education.

At **the Walker Center**, the participants were basically children who did not have access to technology. Racially, the participants were predominantly Afro-American and Hmong, and some Caucasian students.

Some children who came to STUDIO 3D classes at the **Museum Magnet School (MMS)**, in contrast, had Legos and computers at home. But they probably did not have other technologies (digital camera, for example), and they probably did not have anybody who knew how to use the technology at home or could come up with innovative ways for them to use it. The most important part was not only giving them access, but giving them an idea as a starting point. They didn't necessarily identify themselves as gifted and talented, but identified as students who did well structuring their own time and managing their own projects. At the MMS, about 80% of the students were on free or reduced lunch. In terms of gender, there were more girls than boys at that STUDIO 3D. Racially, it was well divided among African-American, Latino, Caucasian, and Asian students.

What was unique about **Youth Science Center (YSC)** was that we the Center got a diverse socio-economic background as well as diverse racial background mixing together. The racial composition of the participants at YSC was fairly diverse, including many Hmong people and Afro-Americans. And the number of girls in the program was significant compared to what could be expected in a science and technology center. As far as ages go, YSC had students all the way through high school, but generally it was 12-14 years old.

At **Landfall**, racially, it was comparatively homogenous, because the mass of the community was white. But the unique thing is that many people were of very low SES. The youth from the YSC came out to Landfall and mixed with Landfall kids in unique ways they would not normally mix. Landfall incorporated students anywhere from as low as 6 to 12 years old, with a greater number of girls than boys.

Sites and Activities

Providing an open workshop environment with intensive support available from staff and mentors, STUDIO 3D Project activities included 3D art modeling and animation serving as an entry point into learning about science and technology; programming and engineering, helping children learn fundamental math and geometry concepts and enabling them to design and program their own computer software; and Web publishing where participants learned how to use the latest Web-publishing tools to create Web pages to share information about projects they were creating and also gained a better understanding how the Internet works.

The STUDIO 3D program at the Landfall Investigation Station site provided children in this trailer park community, located in Minnesota, access to computers, the Internet, educational software programs, digital cameras and handheld computers. Youth at Landfall participated in a number of focused activities. The list of these activities included computer

programming, robotics, digital animations, and basic electrical circuits.

One significant development of support for STUDIO 3D at the Landfall site was the creation of a STUDIO 3D youth mentor team in the Youth Science Center of the Science Museum of Minnesota. Its participants visited the Landfall site on a regular basis with STUDIO 3D mentor staff. Our interviews with STUDIO 3D mentors and staff showed that, volunteering as mentors, the Team Leaders from the YSC helped add a level of depth to the program that enhanced the experience for participants in the program. The team leaders improved the numbers affected by both allowing for larger activities that directly involve more students and also by branching out and interacting with youth who were not involved in present activities. A diverse range of personalities in the Team Leaders better suited the needs of a diverse population at the Investigation Station. The Team Leaders were able to draw students into activities who previously had shown little to no interest in working on similar projects in the past. These peer relationships were a uniquely positive outcome of the involvement of the Team Leaders in the program. The Team Leaders embraced digital technologies in their projects and found new ways to use them beyond what was originally thought they would be able to do.

Being a mentor/teacher at Landfall (as well as at other STUDIO 3D sites) was much different from working at school—the big difference being that Landfall is a drop-in center. Participation in this site's activities was voluntary, whereas at school it was required. As a STUDIO 3D mentor indicated:

> *The challenge at Landfall is making everything fun, or else you have kids running off to some other corner or outside to play football. You have competition with all this other fun stuff that's going on there. So I find that my job is to bring out something fun, but that also has lots of learning. And turning that around, working at a drop-in center helps answer the question of "how do you make learning fun?" Or "how and what can we learn from the fun things we do?"*

Data from interviews, observations, and document analysis suggested that, over the time that they worked on this project, the teens working with Landfall gained skills in communication, teaching technology, playing with ideas, researching activities and merging technology with art and science. They have became knowledgeable about how to use many different kinds of software, from Microworlds to Lego RCX to Flash, Dreamweaver and more. They are comfortable with many kinds of hardware and gadgetry. They were reportedly comfortable with "playing" with art materials, technology and science, not limiting themselves to only traditional applications of the technology they were using, but trying new things, combining unusual materials with techno-gadgets to come up with entirely new ideas, and using chemistry, biology in their work with technology. The skills they gained through playing with and teaching technology may benefit them greatly in school and also in their future endeavors.

This was the STUDIO 3D's second year expanding into St. Paul's Museum Magnet School (MMS) program, another STUDIO 3D site. On this site the project served a diverse population of students evenly split between genders. The focus of the Magnet School participants was to define themselves as independent learners involved in the process of exploration, experimentation, and explanation. MMS sessions took place twice a week during the school year with a monthly-extended day for parents and friends to drop-in. The project participants used "high-technology" (crickets, motors, sensors, computers, cameras, tape recorders, MicroWorlds, the Internet, iMovie), along with "low-technology" (Legos, tools,

paint, glue) to create their projects. The process used made the technology integrated -- students were in charge of their project and process. Documenting their progress on the Web gave the students a permanent and public way to record their work, refer to it later, and share it with others.

At the MMS, the STUDIO 3D activities were grouped into separate areas. Building Stories with Legos was where the students with little or no experience with building materials developed familiarity and construction skills using Legos, motors, sensors, and RCX bricks. Once students built something, they wrote stories for their machines. In Student Puppeteers, students with familiarity with building systems were introduced to engineering with Legos, hand held computers, programming, and they constructed their own interactive theaters. A dozen students were introduced to Real World MicroWorlds software, which children connected to the "real world" with crickets, sensors, simulations, and photos and used a handheld computer to record a change from a sensor (light or temperature, for example). When the changes occurred, the screen graphics were altered. The students charged ahead developing ideas for making their screens change. Winter projects included making miniature art cars that held kinetic sculptures; smart clothes that responded to their wearer and the environment; refrigerator boxes covered in poetry and motorized actions; and Lego projects that told stories. Spring projects included built-from-scratch art cars; kinetic sculpture boxes that used cranks, belts and spools to turn abstract shapes; folktale dioramas with automated characters; MicroWorlds and stop-motion animations; and more story-telling Lego projects.

STUDIO 3D had continued success collaborating with the staff and facilities of Clara Barton Open School, the third STUDIO 3D site. During after-school and in-school activities hosted by Barton School, the students worked on asking questions and testing things out. The main focus of technology explorations was the scientific method: asking questions, developing experiments, coming up with a hypothesis, and documenting the results. For example, using such activity as "Jitterbugs" as a topic worked well. It allowed students to learn about mechanics and circuits, to be creative, and to solve problems. The STUDIO 3D staff Molly Reisman and Meri Gauthier presented their work with Jitterbugs to Minneapolis Public Schools teachers of gifted on April 9, 2003. They were particularly excited about introducing this type of open-ended, inquiry-based style to the enrichment teachers as they saw it as a useful way to integrate differentiation into the classroom.

Also, through STUDIO 3D, there were two enrichment (or Topic) classes and two Options classes at Barton. The third and fourth grade teams in their science rotation focused on building and understanding gears and simple machines, and writing programs using LogoBlocks that make their machines run. By the end of the school year, about 300 Barton students participated in STUDIO 3D activities.

A new STUDIO 3D site, started in November 2002, was the International Center for Accelerated Language Learning (ICALL) School. As the STUDIO 3D mentor Molly Reisman stated, it was a challenging task to teach a group of older students (17-22 years old) with vastly different levels of English proficiency. Nevertheless, the students were highly motivated to learn and mentors were eager to support them. The students were introduced to digital spirographs and writing stories in MicroWorlds application. In the course of those activities, they also developed their technological skills. Over the course of the ten weeks, STUDIO 3D worked with about twenty-five ICALL students.

During 2002-2003, as part of the work with the Youth Science Center (YSC) youth mentor staff, STUDIO 3D also facilitated workshops and drop-in hours in the Playful

Invention Center (PIC), an experimental workshop and program area on the floor of Science Museum of Minnesota, intended to support open-ended inquiry-based activities. To make this area accessible to its target audience, the project supported entrance to the Museum through participation in the STUDIO 3D program and community partners.

Over time, the program developed an audience base (e.g., children and families who are making return visits to the PIC because they had so much fun the first time) and a volunteer base. The majority of activities the project staff and youth participants were doing were technology based, although they also tried to include activities that require only the use of recycled materials – so that people visiting the PIC can take their projects home. The project participants were developing and prototyping new activities as well as adapting and extending the existing activities. They were able to work in the Museum Halls (in the PIC) directly with museum visitors, expanding the experience of the youth involved. They were able to move from being the "students" or "learners" to the mentors or explainers.

One way to bring STUDIO 3D to a broader audience was through its participation in Public Science Day 2003. For the third year in a row, the Learning Technologies Department of the Science Museum of Minnesota was selected, along with nine other Institutions around the U.S., to be a part of International Public Science Day 2003. The theme for 2003 program was "Taking Flight" to celebrate the science and art of flight as it occurs throughout all fields of human endeavor. A team of five youth volunteers from the Youth Science Center at the Science Museum, together with the project leader, set and reached the following goals:

- To compile a group of activities that focus on the basic principles of flight;
- To share the activities with community partners;
- To publish the activities on the internet, so that others can use those activities as part of their classroom/center curriculum;
- To plan and host an event at the Science Museum to celebrate International Public Science Day;
- To create an online space for feedback and ideas.

During a number of site visits, the researcher observed that Team Leaders and almost all the youth were excited and engaged with activities. The energy level was very high.

Certainly, there were challenges. As one of the mentors reflected on what the program's purpose was:

> *Do we provide access and facilitation to kids who are self-motivated? Do we help kids who aren't self-directed get invested in an idea? Do we help kids learn how to work with others and manage their behavior? All of these are fine goals, but it feels difficult to accommodate all of these needs at once.*

Another project staff member noted:

> *...I'm still trying to find that balance between structure and play that allows the kids the most creative freedom. On the one hand, I want the kids to have the freedom to play creatively with materials and ideas (to discover for themselves). And on the other hand, learning how to use tools and methods gives the kids even more creative freedom because they have more tools and ideas to work with.*

According to Molly, a project mentor, while working with ICALL students, "It's been an ongoing struggle to get students to stay for the program, and then it's a struggle all over again to work with students with such a wide range of English skill (from non-

existent to pretty low).” Nevertheless, most of the time she was impressed by how motivated the students were to learn.

Marie, a teacher working with STUDIO 3D, expressed her thoughts about the project participants’ learning as follows:

> *...So what did the kids learn? I usually think of this in two big sections – curriculum and "hidden curriculum" or process and position. By providing many opportunities for students to create and carry out science experiments, students moved forward in their understanding of the scientific method. They also learned about robotics, computer programming, how gears work and how to use technology in creative ways. The "hidden curriculum" is that stuff which kids learn through how we do what we do. I think the students learned that science is accessible, that they can do real science. I think they learned that science supports creativity and diversity. I know they learned science can be FUN.*

Most mentors strongly believed that, through taking part in the program, the students were taking ownership of the technology, thinking about what it could do for them, and feeling comfortable enough with it to go in new directions on their own. The teens who participated in the activities that merged art, science and new technologies were regular children from urban high schools, not the most techno- savvy or science-achieving students in their peer groups. They were recruited for their interest in teaching, technology, and working as a part of a team. The reported result was that each teen gained skills in these areas that they did not have before and that each teen experienced new ways of using interesting gadgets, software and art materials.

STUDIO 3D Participant Survey

Participants were asked to respond to a few different types of items when completing the Participant Survey. This included responding to yes/no questions as well as responding to items on a five-point Likert scale regarding their motivations for attending the project sites and satisfaction with different aspects of STUDIO 3D. Participants were also invited to add comments under seven open-ended questions. There were a few additional forced-choice questions to gain information on each participant’s background, and two open-ended questions to solicit additional comments.

Surveys were administered at three project sites: Landfall Investigation Center, Barton Open School, and Museum Magnet School. A total of 94 feedback forms were collected and analyzed (Landfall – number of respondents N = 8; Barton – N = 64; and MMS – N = 22).

Altogether, STUDIO 3D participants participated in more than 35 unique activities and used a number of educational computer software applications. The Tables 2, 3, and 4,

created for surveyed sites, list those activities and numbers of survey respondents who responded they were involved with them.

Table 2. Activities at the Landfall site.

Activities	**No. of respondents who participated**
Digital Photography/Movie Making	7
Computer Chess	7
Straw Sculptures & Bubble Blowers	6
Jitterbugs	5
Marble Runs	5
Intel Play Cameras	5
Moving Toys using RCX Bricks	5
Computer Special Effects (pig noses and fireworks)	5
Cup Draws	5
Spider Gliders	5
3-D Pictures	5
SunPrints	4
Mobiles	4
Lego RCX Bricks	4
Flash	4
Knex Tower & 3d Marble Runs	4
MicroWorlds	4
Animation—flip sticks	4
Flight Activities	4
Digital Claymation	3
Digital Spirographs (with touch spiro)	3

Table 3. Activities at the Barton School site.

Activities	**No. of respondents who participated**
Lego – simple machines	43
Jitterbug	25
Persona	16
MicroWorlds	3
Structures	3
Lego Chain Reaction Band	3
Other: Self-portrait; clay castle; challenge class	8

Table 2. Activities at the MMS site.

Activities	No. of respondents who participated
Art Cars with crickets	12
Stories and Technology with RCX br	7
Real World MicroWorlds	6
Folktales with crickets	6
Movie Making (Mouse House/Stop Motion)	5
Poetry Boxes with crickets	4
Calder / Kinetic Sculpture Boxes	4
Puppet Theater with crickets	2
Smart Clothes with crickets	2
Inventions with crickets	1

In analyzing and grouping the qualitative comments of participants, several themes emerged that add meaning and context to the information above. Each theme is supported with a small sampling of actual student comments.

What participants liked about their day at STUDIO 3D

Please tell us about your favorite day this year STUDIO 3D /Science Museum of Minnesota activities. Why did you like it?	No. of Survey Respondents
It was fun	16
Like to create something new	6
Accomplished something	5
Like to build things	4
It was challenging	4
Interaction with other kids	2

According to 17% of the respondents, the primary attractiveness of the STUDIO 3D day was that it involved fun:

- *Because it seemed fun.*
- *Because drawing is fun and exciting.*
- *It was fun. I got to build the thing to make my action work.*
- *It was fun decorating because I like art.*

About 7% of the participants liked to create something new or simply to build:

- *I like creative activities, designing, doing experiments.*

- *Because I got to try new things and I got to work with new materials.*
- *I like building things.*

There were responses appreciating those STUDIO 3D days when students accomplished something:

- *I felt like important because I accomplished something.*
- *It made me feel good that I had finished my project.*
- *I got to see how it turned out.*

It seems that some students seek not only fun but challenges and opportunities in their activities:

- *Because we had a lot of trouble doing it, and I like a challenge, the harder, the better.*
- *It was challenging.*
- *It was a little complicated but fun.*
- *There are a lot of possibilities.*

Students also indicated that they liked to interact and do things together with other people, especially with their friends:

- *There are more people there.*
- *Because I built with my friend.*

Using technology at STUDIO 3D vs. at other places

How is using technology here different from using it elsewhere?	No. of Survey Respondents
No similar technology/materials in other places	17
Not different	6
Makes you think	5
Learn more	3
Located in school	3
Help available	2
Own design	2
It's better, more fun	3

There were six respondents who indicated that the project is not really different from other places. However, the vast majority of the students found some differences in what STUDIO 3D offered. For instance, 18% of the respondents believed that they would not find technology and materials similar to STUDIO 3D in other places that offer access to technology:

- *No materials in other places.*
- *Use of different games and programs.*
- *They are different because they don't have cricket or computer to program the cricket.*
- *Here is a vast variety of materials.*
- *We have more and better equipment.*

Over 6% of the students commented in the surveys that their participation in the project made them think, as in the following quotations:

- *You use your brain more.*
- *You have to do a lot of thinking.*
- *At home, I guess I don't think as hard about it as I do here.*

As a consequence, children's "hard thinking" led them to more learning:

- *You can learn more.*
- *Learning.*

The fact that the project was located directly in their schools was also mentioned in the student responses:

- *They are in school.*
- *Because you are in school and it doesn't take any of your time. It's just school time.*

The STUDIO 3D project was also different for some children because help was available there at all times and they could design things by themselves in a hands-on environment:

- *Teachers help.*
- *You build it yourself, it's your design.*
- *You can make things any way you want.*
- *There are hands-on activities and you do it by yourself.*

Relationships with adults

How is relating to adult staff and mentors here different from doing it elsewhere?	No. of Survey Respondents
They are more helpful	22
More knowledgeable	17
Nice and understanding	9
Not different (Barton School only)	7
Do different things in a fun way	6

Seven respondents from the Barton School did not think their relationships with STUDIO 3D mentors were somehow different, whereas a significant number of children listed the following qualities of the project mentors:

Helpful

- *They listen to your problems and help you solve them.*
- *They can help me a lot better, and are very nice. It's easy to work with them.*
- *They help you express your feelings better.*
- *You get extra help.*

Knowledgeable

- *They know science very well.*
- *She teaches scientifically.*
- *They know a lot about it.*
- *They know different things than my teachers.*

Nice and understanding

- *They are nicer.*
- *Use nice manners and nice words.*
- *Understanding.*
- *Sometimes they understand more of what we say.*

Do different things in a fun way

- *They do different things.*
- *Much different.*
- *Fun way of teaching.*
- *They work with us in a fun way.*

Relating to other students

How is relating to other students here different from doing it elsewhere?	No. of Survey Respondents
Work together with friends, as a team	13
Not different (Barton School only)	10
Get along well, understand each other	9
Help each other	5

Relating to other students in STUDIO 3D classes was not different from doing it elsewhere for ten children in Barton School. At the same time, around 15% of the respondents liked the fact that, in STUDIO 3D they were able to work together with friends, as a team:

- *In STUDIO 3D we work together as partners, and it makes us stay on task more.*
- *You work as a team.*
- *My friends and I discuss important stuff.*
- *I can get more ideas from them.*
- *Because you got to bounce ideas off them, and they knew about what you were doing too.*

Getting along well and understanding each other made a difference for another 10% of the participants:

- *We are all at the same level and we understand each other.*
- *They know what they have and how to explain it.*
- *We get along well*
- *We are nice to each other.*

In such an atmosphere children certainly try to help each other, as suggest the following quotations:

- *It's good to have other students around me so I can get advice.*
- *They give me suggestions.*
- *They help you and watch what you do.*
- *Because you got to bounce ideas off them.*

Other places with similar activities

Are there other places in your community where you could do similar things?	No. of Survey Respondents
Yes	46
No	31
Comments:	
No other places	31
Home	18
Museums, library, clubs	12
Classes	3

Forty six respondents (35 of whom were students from Barton Open School) thought that they could do similar things in other places in their community, whereas 31 children did not believe so (including all respondents from Landfall) and wrote the following comments:

- *Nowhere else to go!*
- *Nothing really like this.*
- *A lot of places don't have this kind of helpfulness and materials.*

About 19% of respondents noted that they could do similar things at home:

- *At home I have a computer and Legos to do similar things with.*
- *My Mom loves to teach me about science.*
- *At home because I have some Legos and wheels.*

Fifteen students mentioned resources of museums, libraries, and clubs, as well as the possibility of taking relevant classes:

- *I can go to the Science Museum.*
- *At the Children's Museum.*
- *I go to the library and they do program there.*
- *At Discovery Club we can explore things just like here. They just don't have crickets.*
- *You can take classes.*

Reasons students come to STUDIO 3D

One question of the Participant Survey provided respondents with the opportunity to rate their reasons for coming to STUDIO 3D (in terms of importance): What sorts of things are in place at this center that make you want to come here? The ratings were a 4-point Likert scale with 1 - Not at all important, 2 – Slightly important, 3 - Quite important, and 4 – Very important. The following tables show perceptions of students at different project sites.

Table . Top 5 reasons students want to come to STUDIO 3D in Landfall.

Reason/Mean N = 8	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
friendly/helpful staff **3.8**			2	6
friends **3.6**		1	1	6
close to my home or school **3.5**		2		6
can accomplish my goals **3.5**			4	4
other participants are nice **3.3**	1		2	4

Table . Top 5 reasons students want to come to STUDIO 3D in Barton Open School.

Reason/Mean N = 64	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
friends **3.6**		7	8	45
friendly/helpful staff **3.5**		3	21	34
comfortable, supportive atmosphere **3.4**	1	9	16	35
good place to learn **3.3**	2	6	23	31
can accomplish my goals **3.3**	1	7	22	29

Table . Top 5 reasons students want to come to STUDIO 3D in MMS.

Reason/Mean N = 22	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
good place to learn **3.7**		1	5	16
can do my creative projects **3.6**		2	6	15
can accomplish my goals **3.4**		3	7	12
staff knows a lot **3.3**	2	1	7	12
friends **3.3**	2		9	11

Participant satisfaction with the project services

Next, respondents were asked to rate their satisfaction with the project areas pertaining to availability of technology, quality of technology, staff/volunteers, learning activities, social atmosphere, and location. As all sites, all those areas received ratings that were in the neighborhood of 4 (Satisfied). These seem to indicate that, overall, the participants were satisfied with the project.

Table . Participant satisfaction with the project services in Landfall.

Parts of STUDIO 3D /Mean	Very Dissatisfied 1	Dissatisfied 2	I'm not sure 3	Satisfied 4	Very Satisfied 5
a. Availability of hardware and software **3.86**		1	2	1	3
b. Quality of hardware/software **3.63**	1		3	1	3
c. Staff/volunteers **4.57**			1	1	5
d. Learning activities **4.57**			1	1	5
e. Social atmosphere **4.29**			1	3	3
f. Location **4.25**			2	2	4
g. Drop-in hours **3.86**		1	2	1	3

The Landfall respondents were most satisfied with "Learning activities" (4.57) and "Staff/volunteers" (4.57). The lowest two means were for "Quality of hardware/software" (3.63) and "Drop-in hours" (3.86).

Table . Participant satisfaction with the project services in the Barton Open School.

Parts of STUDIO 3D /Mean	Very Dissatisfied 1	Dissatisfied 2	I'm not sure 3	Satisfied 4	Very Satisfied 5
a. Availability of technology **3.8**	1	1	19	27	12
b. Quality of technology **3.93**		2	11	36	11
c. Staff/volunteers **4.18**		1	9	28	22
d. Learning activities **4.34**		1	2	32	24
e. Social atmosphere **3.92**		1	15	31	12
f. Location right in school **4.08**		2	12	25	21

At this site, the two items with the highest means were "Learning activities" (4.34) and "Staff/volunteers" (4.18). The lowest two means were for "Social atmosphere" (3.92) and "Availability of technology" (3.8).

Table . Participant satisfaction with the project services in the MMS.

Parts of STUDIO 3D /Mean	Very Dissatisfied 1	Dissatisfied 2	I'm not sure 3	Satisfied 4	Very Satisfied 5
a. Availability of technology **4.17**			2	15	5
b. Quality of technology **4.23**				17	5
c. Staff/volunteers **4.36**			2	10	10
d. Learning activities **4.32**			2	11	9
e. Social atmosphere **4.05**			5	11	6
f. Location right in school **4.36**			5	4	13

In the MMS, the two items with the highest means were "Staff/volunteers" (4.36) and "Location right in school" (4.36). The lowest two means were for "Social atmosphere" (4.05) and "Availability of technology" (4.17).

Things that could be better

Are there things that you don't like or think could be better about Studio 3D activities?	No. of Survey Respondents
Yes	22
No	68
Comments:	
I like it the way it is	20
Have more activities	5
More fun	3
More time	2

When asked if there are things that STUDIO 3D participants did not like or think could be better, 68% of students responded "No" and 22% checked "Yes". Twenty respondents liked the project the way it was:

- *I like it the way it is 20*
- *It's just fine.*
- *Interesting, creative, and fun.*
- *Activities are very well planned.*
- *They've got everything you need.*
- *I think everything is perfect.*

- *It is just right already.*
- *Everything satisfies me.*

Some students suggested having more activities in STUDIO 3D:

- *More activities.*
- *You should challenge kids more.*
- *More experiments.*

And for other participants, those activities should be more fun:

- *More fun activities.*
- *You could use more fun and detail.*
- *Some things are boring.*

Extra time for the project activities was an issue for another group of respondents, as the following comments suggest:

- *More time.*
- *If you got to work longer!*

Overall feelings about STUDIO 3D

Another question prompted the participants to express their overall feelings about STUDIO 3D. The highest mean was at the MMS site (4.64, close to Very Positive). Landfall children had "somewhat positive" feelings (mean = 4.00), and close to "somewhat positive" was attitude toward the project in the responses of Barton Open School students.

Table . Overall feelings about the project by the Landfall respondents.

Feelings about Studio 3D	Very positive 5	Somewhat positive 4	I'm not sure 3	Somewhat negative 2	Very negative 1
No. of Respondents	3	1	3	0	0

Mean = 4.0 ("somewhat positive")

Table . Overall feelings about the project by the Barton School respondents.

Feelings about Studio 3D	Very positive 5	Somewhat positive 4	I'm not sure 3	Somewhat negative 2	Very negative 1

No. of Respondents	18	20	19	3	1

Mean = 3.8 (close to "somewhat positive")

Table . Overall feelings about the project by the MMS respondents.

Feelings about Studio 3D	**Very positive 5**	**Somewhat positive 4**	**I'm not sure 3**	**Somewhat negative 2**	**Very negative 1**
No. of Respondents	16	4	2	0	0

Mean = 4.6 (close to "very positive")

Table . Feelings about the project (from an open-ended question)

Feelings about STUDIO 3D (explained)	**No. of Survey Respondents**
I like it	6
It is fun	15
Great learning	10
Boring	8

A number of respondents briefly explained their feelings, as in the following comments:

I like it

- *It's a nice place to be.*
- *I like everything.*

It is fun

- *Lots of fun.*
- *It's interesting.*
- *It's so fun, and I learn so much!*

Great learning

- *Because I can learn a lot about science.*
- *It is a nice way to make kids learn.*
- *I love the need to think.*
- *I think I came out with a lot of information.*

For the eight students from Barton Open School, some things were boring while working on the STUDIO 3D activities:

- *I like it but sometimes it's boring.*
- *It gets boring fast.*
- *Needs to be funer.*
- *More activities!*
- *You should challenge people more.*
- *I feel just like it's another class.*

Finally, the respondents had an opportunity to express their general comments or suggestions about the project. Those comments included statements such as:

- *I'm learning a lot.*
- *Fun*
- *I think it was worth missing a few recesses.*
- *It's fun to go home and tell my parents and sister what I learned in STUDIO 3D today.*
- *I want to do it again next year.*
- *Keep on going!*

Demographics

Table . Duration of attending STUDIO 3D at Landfall site

How long have you been attending the center? (Landfall site only)	No. of Survey Respondents
3-6 months	1
7-12 months	1
Over 2 years	5

Table . How participants found out about STUDIO 3D in Landfall

How did you find out about the center? (Landfall site only)	No. of Survey Respondents
A friend	5
A parent	1
Brochure	1

Table . Frequency of visiting STUDIO 3D at Landfall site

How often do you come to the center? (Landfall site only)	No. of Survey Respondents
2-3 times a week	4
Once a week	1
1-3 times a month	1
Less than 1 time a month	1

Table . Availability of computers in participants' families

My family has a computer.	No. of Survey Respondents
Landfall	
Yes	4
No	3
Barton	
Yes	64
No	0
MMS	
Yes	21
No	1

Table . Access to the Internet in participants' families

My family has Internet access at home.	No. of Survey Respondents

My family has Internet access at home.	No. of Survey Respondents
Landfall	
Yes	4
No	3
Barton	
Yes	64
No	0
MMS	
Yes	20
No	2

Table . Grade of the respondents

Site / Grade Mean	Grade			
	3	**4**	**5**	**6**
Landfall / 3.8	2	2	1	0
Barton / 4.4	17	21	12	13
MMS / 4.3	2	12	7	1

Table . Gender of the respondents

Site / Gender	No. of Survey Respondents
Landfall	
Male	4
Female	3
Barton	
Male	30
Female	34
MMS	
Male	6
Female	16

Table . Racial/ethnic groups of the respondents

With what racial or ethnic group do you identify?	No. of Survey Respondents

With what racial or ethnic group do you identify?	No. of Survey Respondents
Landfall	
African American	2
White	3
Barton	
African American	9
Asian/Asian-American	8
White	31
Hispanic/Latino/Spanish	5
Other	2
MMS	
African American	5
Asian/Asian-American	4
White	8
Other	3

Table . Reported computer ability of the respondents

How would you rate your computer ability? Site / Mean	Very poor 1	Below average 2	Average 3	Above Average 4	Very Good 5
Landfall **5**	0	0	0	0	6
Barton **4**	0	2	22	15	24
MMS **3.8**	0	0	12	2	8

Interviews with the Studio 3D staff

In summer 2003, we conducted 7 individual comprehensive mentor and teacher interviews, using a structured list of questions. Each interview lasted about 30-45 minutes.

Personal Goals of the Project Staff

Personal goals of the project staff were what actually drove the project, what was implemented in the daily activities and communications with young participants. Those goals included the following:

Seeing children develop new ideas for using technology. Over time, children were coming up with things of their own to do, thinking of their own uses for technology:

They had the project's technology and they knew they could use it however they liked. It was not something we were prescribing. We were just explaining how to use these technological things and made them available, and they were coming up with their own uses.

Increasing people's comfort level with technology. Once their skill levels increased, participants had so much more potential or a wider range of ideas about what they could do. A specific example was programming, socially accepted as a very hard thing to do and, ostensibly, left to really smart computer experts. What the mentors at Landfall tried to do in their project activities was to incorporate programming into all age levels of their interaction down to kindergarten children, e.g. in projects that used MicroWorld and Logo programming.

Using technology as a tool of expression. In many cases, many of the kids have unique stories to tell. In case of the YSC students, according to a STUDIO 3D mentor, they came from remarkably diverse background and had things that they generally cared about passionately and were, unfortunately, being exposed to a lot of things bearing negative influences in their lives. But when given the tools and framework around which to develop an expressive project, they were willing to use technology to tell positive stories about their lives. They used digital photography, movie making, and recording sounds to tell those stories.
Providing access to valuable resources. There was a group of people who have no access to resources. This program had a lot of equipment to offer to such people.

Gaining complex understanding of the use of technology versus just having access. Through working with the program that would mesh art, science, and digital technology, the project staff used constructivist philosophy, making projects, making things with digital technology and art.

Learning about technology while teaching, experimenting, and having fun. Teaching something was a good way to learn more about it. A youth mentor explained that "*the Studio 3D team would be a good way to learn about technology while you are teaching and just be able to experiment with stuff, work with some equipment that I wouldn't have access to normally, and have fun*."

Reasons the Students Participate in the Project

A big motivator for STUDIO 3D participants was that they were coming to do their projects. For a number of children, it was also a social motivator that they really liked the adults there or they had friends there and place where they could do things that they want to do with materials or technology that maybe that could not afford or did not have access to. There were many fun activities to do, something more active and more exciting to do than just watching TV at home. It was absolutely new learning experiences for many of them, something that they had never done before. Also, it was a safe place for their parents to drop them off.

At **the Walker**, one of the reasons was that it was fun place to be after school. Children could be themselves, could blow off steam, and could talk to an adult if they wanted to. Another big motivator was that their friends were going. They could use technology too, but it

was a lot about being with their friends and having some place to go after school. The project could fill that need for them.

There was a big sense of ownership in a program. According to the mentors, people involved with **YSC** felt like it was their place. Youth talked about the program in a possessive tense. They said things like, "This is my project. This is where I work." They had a real sense of pride and sense of investment in a place. They put so much work into continuing projects that they would feel lost if they abandoned it. It was the sense of community and friendship that existed there, with well-developed relations with peers as well as with the staff.

Landfall children already had had activities at the Investigation Station, which became an integral part of the community. So, they did not actually say, "We want technology." Instead, they would say, "There is somebody interesting who is going to do something cool or fun, we want to go there." It was unique, creative STUDIO 3D activities and individuals that attracted children. They expected mentors, hoping they would come. Essentially, they wanted mentoring, more adults in their lives. Also, they came simply because they did not have this kind of technology at home. Even in school, they did not have this freedom in using technology.

STUDIO 3D participants in **Barton Open School** had fun and got excited because the nature of it was so hands-on and then there was a computer component that they got excited about. This was the class that they were really going to want to come for. As a volunteer-teacher at MMS indicated, "You could just feel it was a step up in terms of how the children were paying attention."

For the **MMS** kids, they came because it was part of school sort of an enrichment program they could participate in. Students had a choice to come: they did not have to come if they did not want. One big draw was the contrast to the normal school day. Here was the place where they could try things and experiment in a kind of unique education setting that did not constrain them to short-term experience, first of all. All the experiences could be extended over a long duration. They could work on something, but then they could come back and continue in a creative, engaging, interesting environment.

Uniqueness of STUDIO 3D

Mentors did not think that there were many places where the children had access to the same kind of technology that the project offered and were able to use it in the same way supported by the museum. At the Walker, for instance, project participants would draw things and scan them, and then import them into Photoshop and color them and manipulate them there. And it was something that was not offered in other places.

While there are other places in the communities where youth could have access to technology (e.g., schools, libraries, community technology centers, and homes), the STUDIO 3D sites strove to provide a different learning environment. One thing it offered that was different from other places was closely monitored experience, whereas a library, for example, did not necessarily provide mentors, helping children figure out how to use technology to do things. As one mentor remarked,

> *"A library just sort of provides a tool, and you can take a class that teaches you how to search the Web. They will not necessarily give you a digital camera and let you take pictures and then figure out how to make a web page with those pictures."*

Because of the environment the STUDIO 3D participants worked in, everyone was constantly under supervision, not an oppressive supervision, like checking what children were doing, but more a mentored, guided experience. The project mentors geared projects with small numbers of students and always started with what children want to do and tried to find a tool that fit what participants wanted to do. There was probably no such relaxed environment in other places, especially for underprivileged children.

Finally, the goal of the STUDIO 3D was to support creative activities with digital technology. In the words of the program coordinator,

"You can see that the activities come first and the technology is the support mechanism that is always in the background… Our approach here is that a technology is yet another material, which to learn through, and which basically will help to mediate life versus you go to the technology to gain learning."

Walking into STUDIO 3D classrooms, you would see children actively involved in the project activities. There were not students sitting and staring "being taught to." These were students who were making decisions on their learning. They researched, they built, they experimented with different things, and they talked with others about what they were learning. As they started work on their projects and presentations, they were asking questions of each other, and anxiously sharing their new creations. The love of learning was evident in these rooms.

Perceived Outcomes/Impacts of the Project

The STUDIO 3D staff noticed that students who were 9-13 years old seemed to benefit the most. The program seemed to get communicated to boys first. Boys' and girls' desires and needs were reportedly completely different. In terms of an after-school setting, parents were much more cautious with their daughters going into an after-school setting. There was some degree of social slowness to it. The project did get girls but girls usually came in pairs or groups, whereas the boys would often come as individuals. They were looking for some social outlet.

Many of the STUDIO 3D representatives and mentors were not minority. The STUDIO 3D staff considered it a hindrance. Basically, a conduit to minority participants was slower.

People that most benefited were people who were proactive and really cared about technology. The people who were excited about and willing to try new things are more likely to benefit, who had positive experiences in the past. Children who were really creative and did not necessarily have opportunity to use technology in a creative way. Students, who maybe socially were not happy at school, now had a place where they could be treated with the greater respect. At the same time, the project required the commitment from the students, willingness to stick with something, and to come back.

First that came to the mind of a teacher-volunteer were the students who were behaviorally challenged in one way or another (e.g., with ADD, ADHD, inattentiveness). In her STUDIO 3D classes, they were totally involved. Even the parents, attending the classes, noticed that there were very few behavioral problems.

For some students who do not get to use technology much in school or at home, just exposure to it makes it accessible to them. For those who do have access to technology at home, providing an environment where they can determine the direction of a project that they come up with is important. They have more experiences, more exposure, and familiarity with

technology for building things. The children are coming up with their own uses, internalizing what technology is and how to use it. They learn to work independently and take themselves through the whole process. One mentor reflected on it this way:

"When you are designing a project, it is really multidisciplinary. It's like the real world where the things are not cut into like math or reading."

Another project mentor believes that

"..Even if they are not directly working on the project, even if they are not directly involved with STUDIO 3D, they are exposed to the benefits of STUDIO 3D. These kids learning about technology become teachers for others. This increased level of familiarity with technology spreads in a sense."

The project brought increased familiarity with a wide array of science and technology concepts. In a developmental sense, the Landfall STUDIO 3D participants, for example, were comfortable with using some significantly complex computer programs, mechanical tools that will make it easier for them to succeed in the future in tasks that are going to become more and more focused on technology and science, integral parts of modern life. They are going to be much more ready to deal with many challenges.

Many project mentors pointed out that the ability to create something independently translates beyond using the technology into real life, where people have to decide what direction to take. It is about creative problem solving for life, a lifelong mechanism that they learn:

"Our approach allows kids to make their learning sort of part of their growth and they are building themselves in a sense. They are taking advantage of resources when they need them."

According to the project mentors, the project activities empowered children to see computers as a tool that they could get better and better at. Because so much what they did was inquiry, they started to feel an increase in confidence in "If I ask this question, I might be able to find out a way to get an answer for it," and if you have a question, then maybe there is a way to run an experiment to answer it. One STUDIO 3D volunteer told the following story:

I had a parent come up to me and let me know that her husband was really getting a lot of headaches and they were discussing this over dinner one night, and the student said, "We should really try to figure out an experiment about this. You've got a really important question here. This is the question we need to find the answers for. What causes the headaches?" So, they talked together in terms of looking at it as a science experiment. And mom said, "We really hadn't thought about it this way. It was cool that the idea came from the child. Let's look and see what happens right before. What kind of experiment can we do with this?" It seems cool because it's like moving it into the larger arena of decision making and problem solving and that's exciting."

All the respondents commented on many social benefits and the role of the mentors and staff. Mentors can connect, relate to young participants. Children get to communicate with adults who treat them like grown-up people in an informal setting.

A youth mentor talked about STUDIO 3D participants' learning experiences:

"They are learning new things. In giving them access to activities that they have not done before, maybe they'll discover that they are interested in that and then decide to learn more about it and design something when they grow up. It just can broaden their field of interests by giving them samples of things that they normally could not do."

According to a STUDIO 3D volunteer and a teacher at a participating school, the project increased its participants' skill level on computers in a very significant way and gave them some increased confidence and just another point of view in terms of how technology learning can happen:

"It did not have to be totally frustrating, which, in the past, if you want to get better with computers, it was a matter of suffering through. With the inquiry curriculum, when problems come up, it is seen more as a learning opportunity. I do think their skill level went up."

According to the project coordinator, there was a concept of "lower" and "higher" levels of programming in the STUDIO 3D activities. In programming, you had to have a certain level of language use and math concepts because you understand how to see change and use the change in the applications. You cannot get around it. So, there was a lower level of programming, which is graphical, movement, and environmental programming. Then, there was a higher level of programming, which is textual. Children had to develop certain skills, math skills, syntax skills. When students were invested in activities that were engaged with technology, that had anything to do with programming, where they changed the environmental attributes, they were experiencing math in cognitive and physical ways versus the way they learn it in school a lot of times, where you learn abstract concepts.

Essentially, technology was nearly the tool. STUDIO 3D participants learned three different kinds of things. Firstly, they learned technology because they were doing that. Secondly, they learned conceptual ideas about the content whatever it was that they happened to be engaged in. And, finally, they also learned the larger notion of problem solving – when you have a problem in the real world, you figure out the answer, do something about it and see what happens.

Perceived Impact on Student Achievement

What the project staff were trying to do was to teach people how to use technology, but, at the same time, set them free to find out for themselves the ways they can use it better. They taught them problem-solving skills combined with a comfort level in technology. In the future, as the mentors strongly believed, it will improve other aspects of academic study, for example, in terms of critical thinking and logic.

For example, STUDIO 3D participants can build a car and have an understanding of how it works. They might not use the actual engineering terms of the different parts and all the different things that are happening in the car, but they understand what is going on, what the problems were that they had to overcome and what makes it work. At minimum, there was foundation laid for later being able to understand those terms and being able to relate them back to real actual experience. One teacher from a STUDIO 3D participating school was positive that being in the project would help students with the open-ended type of assessments. Also,

in terms of inferential thinking, e.g., on the Basic Skills Reading Test, she could see some increase in achievement. It certainly helped students in such disciplines as math and communication skills in her opinion.

One teacher talked about how the project activities motivated ESL students to speak English. Also, talking about technology engaged an additional specialized set of vocabulary. Another mentor explained that, "In terms of being with other kids and being with adults and doing communicating whether it is documenting their work or whether it is making a movie or whether it is just talking with a mentor, all those things strengthened ESL children's language skills." Eventually, it could boost the academic achievement of this category of underserved students.

An interesting vision of the impact of the project on the participants was expressed by another STUDIO 3D mentor:

In any testing situation, you come upon questions that you don't understand, right? You don't know how to answer. How do you approach the question you don't know how to answer? You can guess. Or you can creatively guess. You can assemble an answer, or you can pull something out of air or out of your memory. But if you have any sort of creative problem-solving strategies, I bet, my theory here is that your guess will be an educated and adept approach to solving that unanswerable question.

Finally, it was a promising result that, according to some teachers-volunteers and mentors, the project made some students excited to come to school. Eventually, it may translate to a higher interest toward school subjects and non-STUDIO 3D activities.

Seven Positive Components of the Project

Nurturing relationships between mentors and students

A number of mentors mentioned that the socialization aspect was very important. The most positive thing was that a number of deep nurturing relationships occurred between mentors and students. One young mentor shared his thoughts about his communicating with the STUDIO 3D participants at the Landfall site:

"Our relationships were really well because all the mentors are youth and maybe just couple years older than some of the kids, the kids could relate to us and they were not afraid of us. They talked to us, joked with use just like if we were their friends, but at the same time since we were maybe three years older than them, they listened to us and took advice from us and they respected us as a teacher and, at the same time, be willing to have fun with us when some of the adults were running activities with the kids, sometimes the kids were more hesitant and would be quiet or not as inquisitive in experimenting because it's an adult. Maybe they could not relate with them as much. With us, it worked really smoothly."

Impact on youth mentors

It seemed to be a great idea to give youth the chance to be mentors instead of just relying on adults because it is an experience that the youth mentors would not have been able to get

elsewhere. The project got them excited and broadened their knowledge on a variety of different technological and scientific interests. They learned a lot from it, according to these mentors:

"I had always been interested in making stop motion-animation videos, but teaching it to the people and exploring it was a lot of fun. It just reinforced that it was something that I really liked. It was a valuable experience. In terms of career, this work on the museum team will go well on a resume if you are ever applying for a job. I would probably like to teach in the future."

Idea of inquiry

Mentors and teachers-volunteers thought that the positive notion was the whole idea of inquiry and how they could "use computer technology to make school curricula clear".

Recruiting good teachers/collaborators

STUDIO 3D staff indicated finding good teachers to work with children as one of the best components. It was a criterion of success to find a good partner who was committed, someone like Karen Timesh and Mari Gouthier, unique people with their own personal visions, with the willingness to engage with the project, to work in the partnership.

The whole idea of this approach to technology was to work with someone who was already thinking in terms of constructivist, activity-based work with youth. Part of the theory, too, is to find the people who understand the constructivist theory, who have children who need this, and then work with them. In other words:

"You need a person, charismatic, who understands the technology, who understands the community, who kind of gets the constructivist piece …and actually would engage us. Then we can supply them, support them. You need to establish this unique connection."

The idea of a supplemental, embedded program in a school

Another positive aspect that was mentioned in the interviews was the idea of providing a supplemental, embedded program in a school. The big change that happened to STUDIO 3D (e.g., in Rondo community) was that, as part of evolution, it was moved from the after-school program to a during-school program because it solved transportation issues, which were the biggest issues due to economic limitations. Parents could not get children there and could not pick them up because they did not have transportation. So, advantage was taken of the fact that students were there during school hours. Then the school manipulated its own program to allow STUDIO 3D people to work there. The evolution basically was from one concept that really would locate this technology in the program in a unique community setting that did not work so well. The lesson was that when you do that, people often have trouble getting access, particularly the underserved families who do not have transportation. So, it was better to place the program in places where they were able to be. The administrators started situating the program wherever it served the most and made it most accessible.

It showed itself an equitable approach, meaning that students who wanted to be in it could get in it. It was completely beneficial to the school and community. In a sense, it either built relationships between a community and the school or made them stronger.

Fun environment

The atmosphere of fun was certainly a positive component of the project. When mentors showed kids something new and got them really excited about it, it was a great experience, full

of fun both for the participants and their guides. For the students participating, just access to new things that they had never seen or done before and in a fun environment was probably the best thing.

Continuation after the project is over

Some STUDIO 3D mentors believed that, in the future, they were not going to stop going to the project sites (e.g., Landfall) as a result of STUDIO 3D being over. It was so simply because the relationships were too positive and too integral to their mission. STUDIO 3D allowed people to continue and expand on these relationships.

STUDIO 3D Challenges

The project went through many changes

According to the program coordinator, the program was "a big, messy program" that was mismanaged at certain points. It was not well understood by the institution itself. It is not clear if it was always understood by the staff fully. It went through many different organizational changes. What is interesting is that when STUDIO 3D went through all these changes, the strength stayed, people who were really engaged stayed there, willing to deal with such changes.

"Drop-in" nature

A hard thing to deal with was the drop-in nature of some STUDIO 3D sites (e. g., at the Walker Center), i.e., to get a large number of children to come consistently, to have a more meaningful interaction with them. It was extremely difficult to choose a drop-in site well so that you could get many students come in and it was convenient for them to come to, but then you would not like shutting out other kids who were not in the neighborhood. You could establish a drop-in site at a community center, but then it might be really hard for children from other communities to come. Many mentors acknowledged that while trying to serve a bigger area, a whole drop-in thing was a tricky approach to figure out.

Limits of focus on digital technology

For some project teachers, at times, it was challenging to come up with continual projects that were focused around just the concepts of digital technology:

"You feel like you run out of a new experience to give them. Focusing on just digital technology has limits in some ways. "

However, much of the work that was done did a good job of reintroducing the concepts that were already taught to the participants. For example, using the digital technology, mentors had to record and document the results of science experiments and teach children in that sense.

Takes much time

The negative side for some teachers was that participation in the project takes significant amount of time. The importance of "reflection time" was stressed in the interviews.

Problems with at least one partnership

The STUDIO 3D staff learned that the institutional partnership can be truly hard to make work. A program administrator described one of such experiences:

"At the beginning of the collaboration with one partner, I really believed that we'll have audience so narrow, and we really couldn't crack out of that, especially working with them because they did not want to facilitate kind of broader audience and they actually did not provide the kind of institutional support that we had hoped for. It seems that they were trying to serve their own needs and not the needs of the program. So, that was negative."

Need more collaboration

The program administrator noted in the interview that a negative fact was also that STUDIO 3D lost its lead in some places, mostly due to lack of collaboration:

"I thought it was a nice and unique chance to try to work with the audience. We needed to inspire more teachers. We did not get audience. We needed more collaboration."

Ways to increase positive impacts for youth participants

More structure

The STUDIO 3D staff believes that the level of structure in the program was positive, and it is still evolving. As far as outreach experience goes, some mentors acknowledged that it was quite a complicated project and they could see more structure there. They would like to have a pool of children who were registered and who made a commitment to come. To be receptive to the fact that children walk in the door and know nothing about any of technology and materials, basically they have no point of entry. Probably, to offer some kind of starting classes that students could enter and learn things in-depth, not like in a school setting, but more in a workshop setting. To give some degree of consistent exposure to one thing. Then, children will have a point to build on. As one mentor said:

"What is the best way to teach them? Some kids just work on their own, some kids see what their friends are doing, but kids need some more structured approach or introduction activity. Doing the project in the school went very well because it's in school and kids sort of know how to behave in school, and the structure already around, whereas in a drop-in site there is very little structure, which can make it really frustrating for mentors and for kids."

It was stressed that figuring out the way to put structure around STUDIO 3D activities to increase benefits for participants would be good but without losing the flexibility and the fun of the "drop-in" environment. This is difficult, especially given the fact that some project participants come one day and do not come another.

Youth working with youth in an ongoing fashion

It was observed that taking the YSC teams out to Landfall dramatically improved mentor-student interaction there and brought in so many more students who had not participated in the project in the past. The STUDIO 3D staff noted that "youth working with youth in an ongoing fashion" approach should be made an integral part of the program from the very beginning.

More new activities

Some teachers would like to expand on project activities. They want to come up with new exciting learning ideas, and be more creative in what they offer to the participants.

Start convincing teachers that this learning style empowers students

One teacher from a participating school saw as the next step the need "to start convincing teachers that this learning style empowers students, and the curriculum just goes deeper, where students are going to build on it." It is important to be proactive in looking for teachers who are open to possibilities and schools with a large degree of flexibility on behalf of administration.

Work with upper-teens (ages 13-18)

The project identified its target audience. What the STUDIO 3D staff would like to do is apply what was learned at this particular target audience (ages 9-13) and apply it to upper-teens (13-18 years old) who seem to be even more underserved. Much was learnt in terms of how mentors think about this issue, i.e., mentors' and staff's desires and capacity to work with these teens. It will be applied to a number of other initiatives.

Develop community relations / Needs assessment

If there were a chance to start this project again, the program coordinator would use a cultural institution to do a series of discussions with communities to identify needs that the community recognizes for youth:

"Then I would take those inputs and I would in some way introduce this kind of program approach that we've taken and through that I feel we could get the kind of feedback that would identify those unique individuals that would take advantage of this initiative. It seems that we will only expand through word of mouth unless we take a bigger step. We have to do is this kind of community relations, PR sort of approach of distributing our ideas."

Increase frequency of sessions / Get more in-depth

A youth mentor would like to get out to "more people and more frequently." It would be a more effective approach to do activities with the same people more regularly. She thinks that if mentors would go to the site at least twice a week, then the project participants could do more complicated projects and could get more in-depth:

"Right now it is once a week. You would do an activity and next week you do another activity, so you would scratch the surface of lots of things, which is cool, too, because it exposes them, and if there is one thing they really like, maybe they go do it on their own time. But it would also be nice to have more time to be able to really talk about one thing in depth."

Tracking participant progress

Database

At the beginning of the program, there was an attempt to build a tracking system that was based on an idea of logging in students. It was a legacy of the Computer Club House system, which included a database that registered and logged in members. But each site had its own unique way. In Barton school and MMS, the project staff tracked basic school attendance. One thing that was not really successful was the attendance tracking with the project's own tools at some community centers. At the Walker, the staff kept track of who came and how much time

they spent at the site. However, at Landfall, a kind of an entry database was built, but it did not work because the volunteers there did not use it regularly.

In terms of what children did, STUDIO 3D always promoted the notion of photographing and mediating their experience. All participants were invited to mediate their own experiences. The project staff collected those experiences, which ended up as portfolios. The project created a website that presented much of children's work.

The Walker and Landfall sites used a database. Children had a folder on a computer where they saved whatever they worked on. There were records of most of their work. In the MMS, the project participants would document their work on a web page. They wrote about what they did that day and they often put a picture of what they did.

Journaling

The staff members also built the journal functions, which they believe were the most successful way to track this program. Journaling was intended both for themselves and students. The staff and mentors made journal entries on their experiences: what their approach might be, what they saw, what they did, and how they felt about their work. Journals were great sources of information, which can be used as ways to look back as a detailed chronicle of the project successes and failures.

Demonstrations

In STUDIO 3D activities in the Barton Open School and MMS, the actual checking to see whether or not students understood usually came through written work or through conversations. When students built a machine, they had to sketch out that machine and describe through writing and diagrams how that it worked. Then, they had to come and talk to the mentors. It was not actual testing, but there had to be some demonstration in terms of what they were doing. There were class and lab group discussions. A teacher from one of the sites expressed the following thoughts:

"I think the core of assessment should be is to really get a clear picture of where kids are at and figure out for this particular kid what is the next step. That's a valid use of assessment. The assessment that's punitive just doesn't serve kids."

Reactions of parents toward the program

According to the staff members, they never tried to get much parental feedback or to make any concrete effort to create a particular mechanism that would reach out to parents. Different staff members would talk to parents at different times if a student had issues. Sometimes the staff had to contact parents to find out information if the student did not show up at a particular time. Also, occasionally, the project mentors talked to some parents during the Open House hours and exhibitions they had at several sites. Those talks revealed very supportive and appreciative attitudes of parents toward STUDIO 3D activities.

At the Walker and MMS, for example, parents were very positive and appreciated the open-endedness of the project, the fact their children could meet other people and be in a safe place while doing things independently. One of the parents at the Landfall site was excited about activities herself and especially about the fact that her child was exposed to something like that. As for the YSC, some parents noted that STUDIO 3D provided children with what

they could not get elsewhere and gave them a direct beneficial result. One project mentor recalled her talk with such a parent:

"One mom said that her son is very smart but doesn't like the school environment and that this program really provided him an outlet for his intelligence to run in a free, but academically challenging fashion."

Conclusions and Recommendations

The following conclusions and recommendations are based on STUDIO 3D data – project staff and participants' reflections, site observations – and an extensive review of the literature on the technology-enhanced learning activities.

Recruitment issues. Annually the recruitment of STUDIO 3D participants was done through visits to Minneapolis Park and Recreation Board parks and programs, visits to community programs and visits to elementary, junior high schools and public high schools throughout Minneapolis. The analysis showed that recruitment always was most successful at sites where there were adults who had taken a particular interest in the program or where there were already young people involved in STUDIO 3D.

Use of technology for after-school activities. The project's experience indicated that doing after-school outreach is a complex activity. Therefore it takes some re-thinking of the goals of the activity and how the specific technology might be presented. With such limited interaction time and the limited attention span that goes along with a voluntary after-school program, the goals must also be redefined. These more defined goals may help better define the activity.

STUDIO 3D mentors indicated that one of the keys to using technology with children is to keep it fun (and not frustrating) and to keep it, like anything else in working with young people, near their level of understanding. Modern technology presents exciting opportunities for creativity, learning, and fun, but it still needs to be adapted to the participants' current level of understanding. Technology has much potential and capability, but it can also be overwhelming—the programming, the electronics, etc.—unless there is a simple enough entry point.

Keeping track of activities. It has been an effective strategy to keep track of and demonstrate what STUDIO 3D participants work on through keeping written and on-line project journals. They record what new ideas students have, how they plan their projects, what works and what doesn't. These are mentors and project participants' notes, in which they focus on expressing their ideas, successes, and challenges.

Building evaluation capacity. As an essential part of the continued accountability process, there should be the longer vision of using the project's evaluation as a basis for building evaluation capacity in the project. It would allow ongoing process of collecting information about the impact upon student learning as a result of participating in the STUDIO 3D Project, as well as generating information for program improvement.

Building the evaluation capacity of the program is critical, as is the willingness of staff to evaluate their efforts. The staff, mentors, and teachers-volunteers can collaborate to identify the impacts associated with the program. They can work to gather information using a range of procedures - performance assessments, observations, samples of student work, and

other indicators of the impact of the project activities on children, as well as surveys and focus groups with students (and parents) about their perceptions toward the project.

One recommendation would be to keep track of each participant across time. It would include an entry questionnaire for first time participants (attitude toward technology, self-report of technology skill level, demographics) and development of a participant database with unique ID's for each participant and data kept throughout the course of the project. Individual longitudinal case studies would be of great value, too.

The project's success and sustainability. STUDIO 3D successfully integrated its programmatic approach into its sites' activities. Project participants were exposed to technology in new ways and learning skills. They were becoming *fluent* with the technology, which involves "not only knowing how to use technological tools, but also knowing how to construct things of significance of with those tools" (Resnick, 2002, p. 33). Qualities and skills developed through their participation in the program—such as patience, communication skills, the ability to learn from each other, understanding how one part of a system impacts another, refining a design, presenting ideas, and being flexible—could help these young people to succeed in any endeavor they may choose. While the project staff bring new ideas and offer a great deal of support, the plan for these sites should be to continue to work towards supporting young people in exploring art, science, technology, and engineering, even without the project's support. The focus should be both on meeting the needs of the young people who participate in the program and securing a legacy for programming like that of STUDIO 3D.

The successful implementation of the program depended in many ways on institutional collaboration. The teachers that were involved with the project, the collaborating schools and community centers' administrators, provided the motivation and leadership needed to effectively implement this complex project. Their involvement will continue to be needed to secure the project's legacy within the schools and community.

It is important to develop ways to evaluate which uses of technology and materials and what approaches provide the most positive outcomes for participating children.
The experience of the STUDIO 3D participants yields important information for centers planning to launch or expand similar programs. The issues that need to be considered include:

- Establishing support at the project site and in the community;
- Providing staff professional development as an ongoing component of the project;
- Providing sufficient opportunity to experiment with new learning approaches;
- Providing opportunities for teachers and mentors to share their experience with others;
- Establishing effective participant progress tracking system and evaluation strategies.

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Acknowledgments

This evaluation would not have been possible without the full cooperation and extensive assistance of the STUDIO 3D administrators, mentors, and young participants. We want to thank them for their cooperation and willingness to participate in this evaluation.

Boris B. Volkov
Jean A. King

Further information about this study can be obtained from:

Boris B. Volkov
Jean A. King
Evaluation Studies Program
Department of Educational Policy and Administration
University of Minnesota
330 Wulling Hall
86 Pleasant Street SE
Minneapolis, MN 55455-0221

APPENDICES

Reasons students come to STUDIO 3D

Table . Reasons students want to come to STUDIO 3D in Landfall.

Reason/Mean N =8	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
a. close to my home or school **3.5**		2		6
b. it's free **2.38**	3	1	2	2
c. computers **2.75**		5		3
d. Internet **2.25**	3	1	3	1
e. other technology **3.13**		1	5	2
f. good place to learn **3.25**	1	1	1	5
g. can do my creative projects **2.75**		4	2	2
h. can accomplish my goals **3.5**			4	4
j. knowledgeable staff **3.13**	2		1	5
k. friendly/helpful staff **3.75**			2	6
l. friends **3.63**		1	1	6
m. other participants are nice **3.29**	1		2	4
n. no one laughs/looks down on me **2.63**	2	1	3	2
o. comfortable, supportive atmosphere **2.88**		3	3	2
p. socializing **2.86**	1	1	3	2

Table . Reasons students want to come to STUDIO 3D in Barton Open School.

Reason/Mean N =8	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
a. located right in school; no need to go somewhere else **2.61**	5	22	26	8
b. it's free **2.61**	13	13	21	15
c. computers **2.72**	6	16	27	11
d. Internet access **2.48**	10	23	18	11
e. other technology **2.79**	3	17	31	10
f. good place to learn **3.34**	2	6	23	31
g. can do my creative projects **3.10**	3	10	26	22

Reason/Mean N =8	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
h. can accomplish my goals **3.34**	1	7	22	29
j. staff knows a lot **3.12**	2	11	26	22
k. friendly/helpful staff **3.53**		3	21	34
l. friends **3.63**		7	8	45
m. comfortable, supportive atmosphere **3.39**	1	9	16	35
n. other (please add): good supplies> learning with my hands> fun –2 **4**				4

Table . Reasons students want to come to STUDIO 3D in MMS.

Reason/Mean	Not at all important 1	Slightly important 2	Quite important 3	Very important 4
a. located right in school; no need to go somewhere else **2.41**	2	9	11	
b. it's free **3.14**	2	5	6	9
c. computers **3.1**	1	4	8	7
d. Internet access **2.5**	5	6	6	5
e. other technology **3.0**		6	8	6
f. good place to learn **3.68**		1	5	16
g. can do my creative projects **3.57**		2	6	15
h. can accomplish my goals **3.41**		3	7	12
j. staff knows a lot **3.32**	2	1	7	12
k. friendly/helpful staff **3.29**	1	3	6	11
l. friends **3.32**	2		9	11
m. comfortable, supportive atmosphere **3.25**	1	4	4	11
n. other (please add): space> it's fun> nice job> during school time> not competitive> a good place to think> materials **4**				8