Teenage Designers of Learning Places for Children:
Creating After-school Environments for STEM Education

Summative Evaluation

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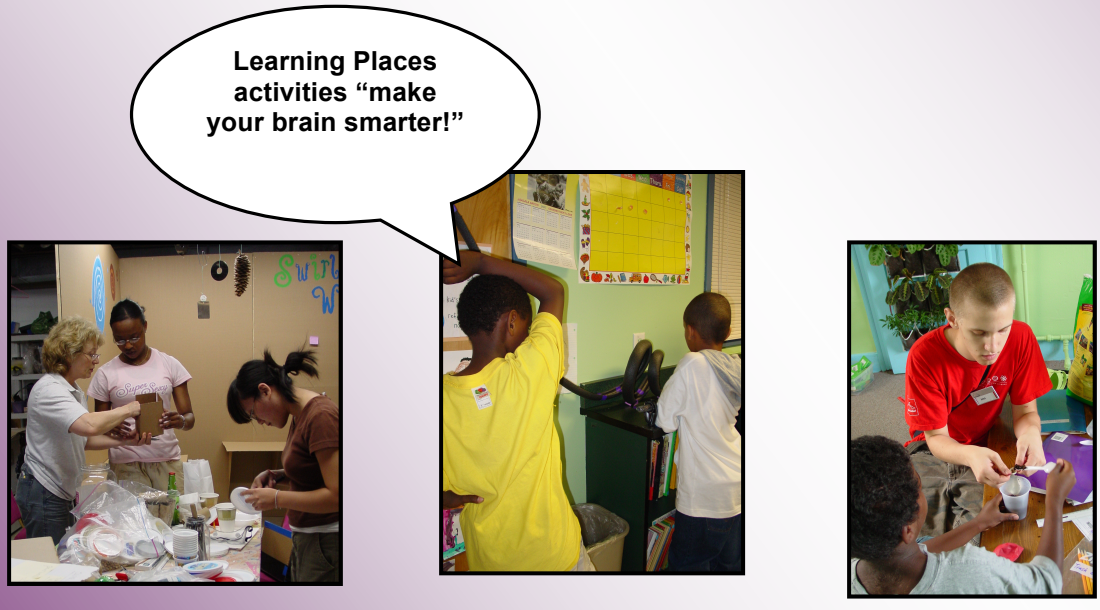

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EXECUTIVE SUMMARY

"Teenage Designers of Learning Places for Children: Creating After-school Environments for STEM Education," commonly called Learning Places (LP), was funded through the National Science Foundation (NSF) September 2005 through August 2009 (#ISE-05155732). In LP, museum staffs from the Saint Louis Science Center (SLSC) and the Science Museum of Minnesota (SMM) engaged inner-city teenagers from traditionally underserved populations in designing "*learning places*" for younger children in after-school centers. As described in the original proposal to NSF, "a *learning place* consists of activities designed to teach STEM (Science, Technology, Engineering and Math) concepts and processes, as well as contexts for implementing these activities, including both the design of physical space and strategies for integrating the activities into existing after-school programs."

Additional partners included community organizations that provide after-school and summer programs for children – four organizations (five sites) in St. Louis and four CommonBond Communities sites in St. Paul with programs for children at each site. Curriculum and professional development support were provided through January 2007 by the City Technology project at the City College of New York. In the fourth year of the project, staff from St. Louis and St. Paul supported implementation of Learning Places in youth programs at five geographically diverse museums, Phase 2 Museums. These partnering museums included Explora, Headwaters Science Center, Lower Hudson Valley Challenger Center, Pacific Science Center, and Sci-Port. (See Appendix A for a flisting of partners.)

The external evaluator provided formative and summative evaluation using qualitative and quantitative methods, including interviews, focus groups, observations, embedded assessments, surveys, an Origin/Pawn assessment, and analyses of videos, photos and documents. (See Appendix C for a list of data collected.)

Unique Features

The unique nature of the Learning Places program offered interesting opportunities and challenges for the program evaluation. The most unique feature of the Learning Places project was the involvement of teenaged youth from local communities designing spaces and activities for younger children from those same communities. While each site applied this feature in different ways, each site used the experiences of the teens to help build a stronger connection to their communities.

In St. Paul, SMM partnered with CommonBond Communities, Minnesota's largest provider of affordable housing with services. Four Advantage Centers at four CommonBond locations were involved in Learning Places, each located in a low-income housing development. Teenagers were recruited from the four

CommonBond locations, which meant teens would work on creating *learning places* in the after-school programs within their own housing community. Several teens had younger relatives engaged in the *learning places* they created.

In St. Louis, SLSC partners with a wide variety of community groups. Five were selected for Learning Places: one early child program, one for girls, one homeless shelter, one after-school program in a school building and one community-based club for all youth. LP teenagers were recruited from the larger SLSC Youth Exploring Science (YES) program, with over 150 youth from across the many community partners' programs. Some St. Louis LP teens created *learning places* for children in their home community center while others created places in centers like that from which they were recruited.

The principal investigator (PI) and external evaluator remained on the project throughout the four years. Unfortunately, all the Co-PIs and project staffs changed (described in the Findings section of the report). This turnover in leadership led to changes in the project. This unique situation with turnover in multiple sites provided interesting data while making analysis challenging.

Another unique feature was the involvement of the Phase 2 Museums. Each of the five partnering museums engaged youth in developing *learning places* in collaboration with a community partner as part of a $10,000 mini-grant to each Phase 2 Museum in the fourth year of the project. Each used their project to address different community needs.

Summary of Findings

To summarize the findings presented in the full report, each project goal is listed below with a brief overview of findings.

Children' s STEM Learning

Goals for children included: 1) promote understanding of STEM concepts; 2) develop problem-solving capacity and engagement; and, 3) develop passion for investigation and design, and thereby motivate further study of STEM subjects.

Summarized Findings: For children in Learning Places, there was little evidence of deepening their understanding of STEM concepts; however, it was clear that the children engaged in the process of science, often using new tools of science. They were eager to investigate new phenomena. While we found no firm evidence regarding their motivation for further study of STEM subjects, anecdotal evidence suggested some children continued to work with the materials at home.

Teenagers' STEM Learning and Sense of Agency

Goals for teenagers included: 1) promote deeper understanding of STEM concepts, which includes creative problem-solving and design capacity; 2) encourage willingness and ability to approach problems analytically; 3) develop self-images as agents of change with internal locus of control; and, 4) consider

careers in STEM areas, particularly STEM education.

Summarized Findings: In years two and three of Learning Places, teens at SMM and SLSC participated in focus group interviews, and a sample of those teens were interviewed individually to assess their understanding of the STEM concepts they used in the *learning places*. The interactive interviews involved activities and novel questions for the teens to examine. For example in the third year, St. Louis teens examined plants in the interviews and St. Paul teens addressed parachutes based on concepts used in the *learning places* they created. In both cities in year three, teens explored colors with colored water and lights as they explored various combinations through the interview process.

Even though the understanding of key STEM concepts varied greatly from teen to teen based largely on prior knowledge rather than new learning through the project, almost all teens developed solid problem-solving skills and a willingness to reason through the questions and challenges presented in the interviews.

Additional findings related to teens are:

- Teens developed comfort with adults resulting in confidence in communication with program staff, community partners and community leaders.
- Teens developed social skills and confidence in peer interactions.
- Teens developed comfort with people different from themselves.
- Through teaching younger children, teens developed social skills and saw how they could impact the lives of children.
- Opportunities to travel and meet important people built self-esteem.
- Knowing STEM content built status with peers and self-confidence in school.
- Opportunities to speak publicly to groups of children, peers and adults built confidence.
- Public praise and criticism impacted self-image.
- Self-image and sense of agency improved with real, meaningful work.
- When teens acted independently while staff guided, teens developed leadership skills.
- When teens succeeded in facing challenges and solving meaningful problems, they were empowered.
- A safe, supportive, non-judging community had a positive effect on self-esteem, while the opposite also held true.
- Teens developed a sense of agency when they knew their ideas mattered.
- Debriefing, evaluating and reflecting upon their work helped teens see the impact of their actions and thus develop a sense of agency.

Increased Capacity of Program Staffs at SLSC and SMM

Goals for youth program staff at SLSC and SMM included: 1) develop intention and capacity to modify existing programs for emphasis on specific STEM learning objectives, and 2) develop strategies for collaborative design with

community organizations.

Summarized Findings: Emphasis on STEM learning by each the four program managers in LP (two at SLSC and two at SMM over the first three project years) was directly related to the staff's comfort with STEM content. Evaluation found the intention and capacity to modify existing programs was directly related to this comfort level. No new program focus on STEM learning objectives as a result of LP was observed. There was, however, a change in emphasis on inquiry related to staff training through the LP project.

Each site developed strategies specific to their museum and community needs. For example, one successful aspect of the collaboration at the local level in St. Paul was the group of local advisors who met with LP teens to provide feedback on designs, help provide materials for the *learning places* and support the Youth Summit. Unfortunately, as staffs changed, this group ceased to meet. Another successful and critical aspect in St. Paul was the role of the Liaison between CommonBond and SMM. The Liaison met individually with teens and their parents throughout the project and took action when needed to ensure each teen was as successful as possible.

In St. Louis, the local collaboration with an architect at Fox Associates provided the teens with design experience as they created their *learning places*. Collaboration with a local technical school provided some of the materials for the *learning places*.

Increased Capacity and Institutionalization of LP at SLSC and SMM

Goals for other staff and administrators at SLSC and SMM included: 1) increase capacity and interest in engaging with more diverse audiences, and 2) institutionalize collaborations initiated by the project.

Summarized Findings: Survey data were not available from SLSC or SMM, and there was no evidence to determine a change in capacity, interest or actual audience, though anecdotal evidence suggested SMM and SLSC audiences continued to diversify. This may or may not have had any direct relationship with Learning Places.

As the project ended in both cities, there was a clear effort to institutionalize the collaborations. By the end of the Learning Places grant, both museums were actively seeking new funding sources to continue to build on the successes of Learning Places with their community partners.

After-School Program Staff Changes

Goals for administrators, staff and volunteers at nine partnering after-school centers included: 1) recognize STEM education as part of program mission; 2) develop capacity and motivation to promote STEM learning; and, 3) those currently in school consider careers in STEM areas, particularly STEM education.

Summarized Findings: The administrators at the partnering community centers recognized that regular turnover of afterschool and summer program staff was an issue and moved to address the issue. For example, CommonBond hires AmeriCorps staff with the understanding that they stay one or two years and move on. SMM teen and adult staffs created the motivation for CommonBond to offer STEM opportunities for their children through LP at the four sites. Knowing the teens' role in the project was coming to an end and AmeriCorps staff would stay yet have regular turnover, the partners created the opportunity for AmeriCorps staff to train and continue the work of the teens. The collaboration was meeting the needs of CommonBond, created by motivating them to offer STEM opportunities to children.

In St. Louis, community partners had the motivation to offer STEM activities before the LP project began. During Learning Places, the partners continued to rely on the teens to provide activities and provide expertise rather than taking on that role themselves. The LP program offered five sites the opportunity to explore new ways to offer STEM engagement and to collaborate. However, after the *learning places* were created, there remained a strong tendency by the community centers to return to the same way they had always worked together, with SLSC providing the expertise, activities and facilitators.

Expanding to the Phase 2 Museums

Goals for administrators and staff at Phase 2 Museums included: 1) develop capacity and motivation for STEM education in nearby low-income communities, and 2) institutionalize collaborative projects in support of STEM education in low-income communities.

Summarized Findings: Each Phase 2 Museum began the project with a different degree of experience with teens and youth programming. Each began from a different type of relationship with their community partner. All five partner museums involved teenagers in creating *learning places*. Some teens led activities with younger children, some created physical spaces, and those with the Challenger Center served as coaches to younger students on a robotics team. Each museum found out just how busy teens can be with school, sports, work and family commitments. They found the teens to be good role models for younger children. Most partners found most of their teens to be interested, capable, and responsible, yet none were without occasional problems.

By the end of the LP evaluation, all Phase 2 Museums reported anecdotally their intent to continue their collaborative projects into the future. The evaluation ended before institutionalization of projects could be determined.

Grounded Theory

The findings summarized above describe results of the evaluation in terms of the project goals, as is typical in program evaluations. Since the Learning Places

evaluation used naturalistic inquiry aimed at understanding rather than a more traditional approach, such a list of findings merely provides a backdrop for the grounded theory that emerged from the process. By its very nature, grounded theory should enable prediction and explanation of behavior, advance the theoretical underpinnings of the field, have practical applications, and guide further research (Glaser & Strauss, 1967). If this report is successful, the theories put forth here will evolve as others apply and study them.

Through the evaluation of Learning Places, five areas of theory and related hypotheses emerged: STEM learning, agents of change, teens as designers, community partner engagement and national collaboration. Each is described in more detail in the full report.

Theory: Success in STEM classes in school requires key foundational experiences. When children and teens miss these experiences, they miss key concepts. After-school programs can provide rich experiences to lay the foundation for further STEM conceptual understanding in and out of school.

Hypothesis: One factor involved in the achievement gap is the lack of foundational experiences needed prior to exposure to more advanced concepts in school.

Hypothesis: After-school programs could fill an important need in low-income families by providing rich, foundational experiences.

Theory: Guiding children and teens in investigations to create rich STEM experiences requires after-school program educators who understand inquiry and are comfortable with the STEM content and materials. Guiding those educators to lead such experiences requires additional personnel, in this case at the museum, who have the skills to train educators in leading investigations and who have a high degree of STEM comfort themselves.

Hypothesis: Educators in museums and community centers can become champions for investigations and rich experiences.

Hypothesis: For museum educators to train teens and after-school program staffs, they must develop the necessary train-the-trainer type skills.

Hypothesis: All educators must acknowledge their own lack of comfort or experience, seek support from others, and develop the comfort and experience necessary before leading children through those experiences.

Theory: Educators must see themselves as agents of change before they can expect that of the teens they are guiding.

Hypothesis: To support teens in seeing themselves as agents of change, staff must be hired who see themselves in that light, or staff must receive the training and support to get there.

Theory: Teens find teaching younger children to be meaningful. Providing teens with meaningful roles as educators gives teens a sense of agency.

Hypothesis: Running through activities with peers before leading the activities with children leads to greater success and thus greater sense of agency on the part of the teens.

Hypothesis: Leading activities in the same fashion and doing what has always been done does not lead to improved sense of agency.

Theory: Designing *learning places* requires skill in design, STEM content and pedagogy. Involving teens in the process enriches the outcome. For teens to take the lead in this design process requires extensive training and resources.

Hypothesis: While *learning places* could have been designed by professional designers and educators, teen involvement in the process created a richer experience for the children.

Theory: When community partners are clear on project goals, engaged in the development of the project, and invested in the outcome, they are eager to sustain successful projects.

Hypothesis: The more involved the community partners are in the planning and development of the project, the more likely they are to sustain the project after the funding ends.

Hypothesis: The more community partners' front-line staff can be involved the planning to share the goals, the more they are likely to support the project and help to sustain it.

Theory: National collaborations with multiple partners in different settings and geographical locations require clear communication, clearly defined roles, strong leadership and similar philosophies. As the project evolves, so must the communication, roles, leadership and even the philosophy.

Hypothesis: Successful complex projects evolve as relationships stabilize, allowing the projects to progress.

Hypothesis: When technologies support clear and regular communication, the collaboration remains focused on project goals and audience.

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INTRODUCTION AND PROJECT DESCRIPTION

The National Science Foundation (NSF) funds projects that advance the Informal Science Education (ISE) field overall by "pushing the envelope" at the frontiers of the field and leveraging resources of partners through collaboration. They seek projects that are innovative, generally involving risk. "Teenage Designers of Learning Places for Children: Creating After-school Environments for STEM Education," commonly called Learning Places (LP), was one such project, with funding from September 2005 through August 2009 (#ISE-05155732).

In the Learning Places project, museum educators from the Saint Louis Science Center (SLSC) and the Science Museum of Minnesota (SMM) engaged inner-city teenagers from traditionally underserved populations in designing "Learning Places" for younger children in after-school centers. As described in the original proposal to NSF, "a Learning Place consists of activities designed to teach STEM (Science, Technology, Engineering and Math) concepts and processes, as well as contexts for implementing these activities, including both the design of physical space and strategies for integrating the activities into existing after-school programs."


LEARNING PLACES PROTOTYPE AT TORRE

Additional partners included community organizations that provide after-school and summer programs for children – four organizations (five sites) in St. Louis and four CommonBond Communities sites in St. Paul. Curriculum and professional development support were provided through January 2007 by the City Technology project at the City College of New York. In the fourth year of the project, staff from St. Louis and St. Paul supported implementation of Learning Places in youth programs at five geographically diverse museums. These Partner Museums included Explora, Headwaters Science Center, Lower Hudson Valley Challenger Center, Pacific Science Center, and Sci-Port. (See Appendix A for a full list of LP partners.)

The Learning Places project was designed to achieve the following impacts:

1. Promote learning of STEM concepts and processes by adolescents and children through innovative hands-on STEM learning experiences in informal settings.

2. Engage staff and administration of science museums and after-school centers in support of STEM education in low-income urban communities.

3. Develop and disseminate a model for collaborative design and implementation of STEM learning opportunities by university faculty, science centers, community centers, youth organizations and teenagers.

PROJECT GOALS AND DELIVERABLES

The Learning Places project established the following goals and deliverables in its proposal to meet the needs of the participants and the stakeholders.

Figure 1. Project Goals

Goals

1. For Children:
   a. Promote understanding of STEM concepts
   b. Develop problem-solving capacity and engagement
   c. Develop passion for investigation and design, and thereby motivate further study of STEM subjects
2. For Teenagers:
   a. Promote deeper understanding of STEM concepts, which includes creative problem-solving and design capacity
   b. Encourage willingness and ability to approach problems analytically
   c. Develop self-images as agents of change with internal locus of control
   d. Consider careers in STEM areas, particularly STEM education
3. For Youth Program Staff at SLSC and SMM:
   a. Develop intention and capacity to modify existing programs for emphasis on specific STEM learning objectives
   b. Develop strategies for collaborative design with community organizations
4. For Other staff and administrators at SLSC and SMM:
   a. Increase capacity and interest in engaging with more diverse audiences
   b. Institutionalize collaborations initiated by the project
5. For Administrators, staff and volunteers at nine partnering after-school centers:
   a. Recognize STEM education as part of program mission
   b. Develop capacity and motivation to promote STEM learning
   c. Those currently in school consider careers in STEM areas, particularly STEM education
6. For Administrators and staff at museums in other cities along with personnel at partnering local after-school centers:
   a. Develop capacity and motivation for STEM education in nearby low-income communities
   b. Institutionalize collaborative projects in support of STEM education in low-income communities

Figure 2. Project Deliverables

Deliverables for the project included:

- Learning Places in the nine community centers
- Learning Places projects at the five partner museums
- A Resource Guide that provides "complete instructions for producing the *learning places*, including materials lists, activity descriptions, sample work by children, photos, and implementation strategies across diverse settings
- A Narrative Record "of the collaborative experiences of the project, written in the voices of adult and youth participants"
- A Research Agenda created directly out of the questions that arose through the course of the project

LOCATIONS AND ACTIVITIES

The Learning Places project involved a variety of activities and components to achieve its goals and provide its deliverables. In the first three years of the project, activities occurred in St. Louis and St. Paul at the two partnering museums and their nine community centers. In the fourth year, activities were expanded to the five partner museum sites. (See Activities in Appendix B.)

In St. Paul, teens explored STEM activities and design principles with a prototype Learning Place installed at one CommonBond Advantage Center in spring 2007. Building on that experience, and in partnership with staff at three additional CommonBond sites, teens developed portable *learning places* through fall 2008.

In St. Louis, teens explored STEM activities and design during the first two school years. Each summer, teens led a series of short activities for a week in each of five community centers. With the hiring of a new program manager in fall 2007, teens created physical *learning places*, with five *learning places* installed in summer 2008.


YOUTH SUMMIT – PROTOTYPING DESIGNS

Two Youth Summits were held in St. Paul for representatives from both cities. In summer 2006 and fall 2008, teens came together to focus on the design of *learning places*.

On the national level, the five partnering museums, called Phase 2 Museums, were included in each national Collaborative Design Team meeting. Each partner initiated a local collaborative project with $10,000 in funding from the national Learning Places project in Year 4 of the project.

EVALUATION OVERVIEW

THEORETICAL FRAMEWORK AND METHODOLOGY

The basis for the evaluation strategy was a constructivist paradigm with methodology aimed at understanding (Guba and Lincoln, 1994). Thus, the basic beliefs underlying the evaluation were consistent with the principles guiding the program elements; that is, a constructivist view in which new understanding and knowledge were built upon existing knowledge and were constructed actively through social interaction. This paradigm led to a methodology in which the goal was understanding the constructions emerging from the project participants and stakeholders as the project progressed.

METHODS

Qualitative and quantitative methods included interviews, focus groups, observations, embedded assessments, surveys, an Origin/Pawn assessment, and analyses of videos, photos and documents. (See Appendix C for a list of data collected.)

Interviews were conducted with principal investigators (PIs) and senior personnel annually. *Focus group interviews* were conducted in each pilot city with the teenagers, children, and after-school staff participating in the project. A selected smaller sample of the teenagers were interviewed individually after the focus group interviews to gain additional information on the project.

Observations were made in St. Paul and St. Louis, observing the teens in the design process, the children in the *learning places*, and interaction of staff, teens and children.

Documents collected included: teen journals, staff journal entries, blogs, photos, videos, and meeting notes. The analysis of blogs and journal entries is described further under Findings.

Embedded assessments included activities and spaces created by the teens.

Surveys were collected from Community Partners in St. Paul and St. Louis. The Wilder Collaboration Factors Inventory (Mattessich, Murray-Close & Monsey, 2001) was used as the project began as part of the formative evaluation. Attempts to collect pre and post community involvement surveys from SLSC and SMM failed, so are not included in the summative evaluation.

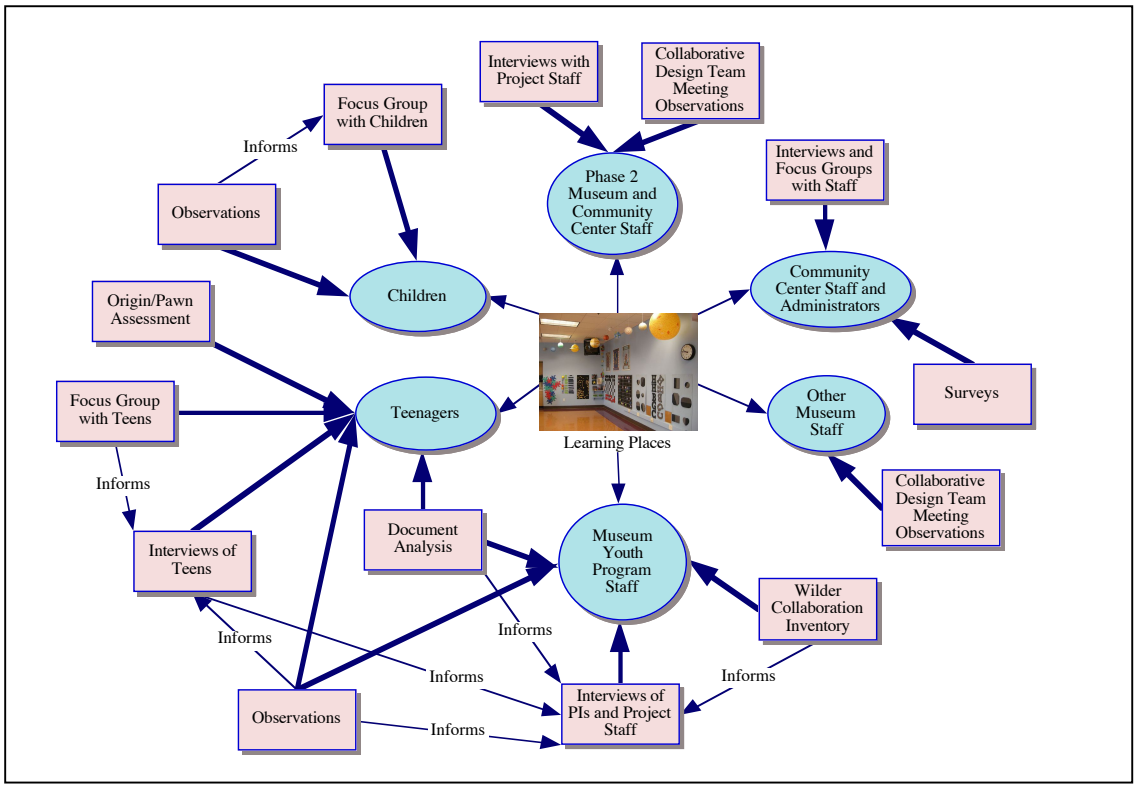
The *Origin/Pawn Assessment* was new to informal science education settings. We were interested in the impact of the project on the teens' self-image (Goal 2. c.). Was their locus of control internal or external? That is, did the teens' feel they controlled their own activities and learning or were the activities imposed on them? Did they originate their own activities or were they more like pawns in the process? To assess this development of the teens' sense of self-agency, we

used the assessment and scoring manual developed by Richard deCharms (1989) for children and teachers in public school settings. This measure involved content analysis of six short stories written to verbal cues. (See additional information under Findings.)

There was a conscious decision in the planning process to eliminate pre and post assessment of STEM knowledge by teens or children. Because content was changing and activities were inquiry-based, we chose to use observations, focus groups, interviews and document analysis instead.

The graphic below illustrates the method of data collection for each of the audiences. The methods (in rectangles) were used to collect information (thick lines) on audiences (ovals) and some data collected from them informed (thin lines) the data collection process for other methods. For example, data from the focus group interviews with the teens provided information on goals related to the teens and informed the questions used in the interviews of the teens.

Figure 3. Evaluation Activities



UNIQUE PROGRAM FEATURES

The unique nature of the Learning Places program offered interesting opportunities and challenges for the program evaluation. The program involved two pilot sites (SLSC and SMM) and five Phase 2 Museums, each with different program designs.

YOUTH GIVING BACK TO THE COMMUNITY

Teenagers designed spaces & activities in their own communities.

The most unique feature of the Learning Places project was the involvement of teenaged youth from local communities designing spaces and activities for younger children from those same communities. While each site applied this feature in different ways, each site used the experiences of the teens to help build a stronger connection to their communities.

The involvement of the teens in the design process provided the *learning places* with a perspective often missing from learning settings.

TWO PILOT SITES

The St. Paul and St. Louis sites differed in youth-community connections, in staffing, and in youth program design. This allowed for comparing and contrasting programs.

Youth-Community Connections

St. Paul teens were recruited from four CommonBond housing communities.

In St. Paul, SMM partnered with CommonBond Communities (CBC), Minnesota's largest provider of affordable housing with services. Four Advantage Centers at four CommonBond locations were involved in Learning Places, each located in a low-income housing development. Teenagers were recruited from the four CommonBond locations, which meant teens would work on *learning places* in the after-school programs within their own housing community. Several teens had younger relatives engaged in the *learning places* they created.

The staff at CommonBond and SMM collaborated on the proposal for Learning Places and created a Liaison position between the community organization and museum to work with the youth and their families as a means of supporting their participation in the program.

St. Louis teens were recruited from many community centers.

In St. Louis, SLSC partners with a wide variety of community groups, and five were selected for Learning Places: one early child program, one for girls, one homeless shelter, one after-school program in a school building and one community-based club for all

youth. LP teenagers were recruited from the larger SLSC Youth Exploring Science (YES) program, with over 150 youth from across the many community partners' programs. Some St. Louis LP teens created *learning places* for children in their home community center while others created places in centers like that from which they were recruited.

Staffing

Staff turnover at the two museums could not have created a more unique opportunity if it had been planned. In St. Paul, the first program manager had a strong science education background and several years' experience in youth development at SMM. She was comfortable with the STEM content and with inquiry. In St. Louis, the first program manager had extensive youth development experience having worked in a community center prior to joining the SLSC staff several years before Learning Places. Thus, both managers were comfortable with the teens but only the St. Paul manager was comfortable with the STEM content.

Staff turnover at the museums provided unique opportunities for the evaluation.

When the St. Paul manager left SMM as her family moved to another state, the new manager came in with a background similar to that of the St. Louis manager. She had extensive experience with teenagers but was uncomfortable with the STEM content. Shortly after the change in St. Paul, the St. Louis staffing situation changed. This time, the new St. Louis manager's background mirrored that of the first St. Paul manager with great comfort in STEM content and several years' experience in youth development at the museum. The one difference between the two was their training in inquiry, with the first St. Paul manager well versed in inquiry and the second St. Louis manager receiving inquiry training through the Exploratorium's Institute for Inquiry several months after joining Learning Places.

Hiring the former program manager as project consultant added continuity.

An additional unique feature was the hiring of the first St. Paul program manager (who was also a Co-PI) as a consultant on the project after she moved. This provided a continuity and program memory that would have otherwise been missing.

Local STEM education experts filled the content expertise gap when the STEM expert left the project.

When the Co-PI and STEM curriculum expert from City Technology left the project in 2007, leaders realized they needed to bring in more expertise in STEM content. As a result, a local expert was hired in each city to work with the program manager. Thus, at SLSC and SMM, teens were led by a program manager and a person with training in science and science education in the last half of the project. This unanticipated addition provided richer data for evaluation analyses.

The PI & Evaluator remained on the project while all other project staff & Co-PIs changed.

Leadership Turnover

The project was fortunate that the PI and External Evaluator remained on the project throughout the four years. Unfortunately, all the Co-PIs and project staffs changed. As was previously noted, the SMM program manager remained with LP for the full four years, though changed her role from co-PI to consultant. One consultant, expert in youth development and informal science education, also remained with the core planning team for the full four years. These changes in leadership are described in the Findings section below. This turnover in leadership led to changes in the project. This unique situation with turnover in multiple sites provided interesting data while making analysis challenging.

FIVE DIVERSE PARTNER MUSEUMS

Each of the 5 partner museums had different projects, goals, and audiences.

Each of the five Phase 2 Museums engaged youth in developing *learning places* in collaboration with a community partner as part of a $10,000 mini-grant to each partner museum in the fourth year of the project. However, each used their project to address different community needs.

At **Explora** in Albuquerque, NM, teens created portable physical spaces to take activities to younger children in their local community at city parks and community centers. Educators, exhibit developers and production staff at Explora worked with the teens, who were high school juniors and seniors. Youth from Explora visited the youth in St. Louis each summer, creating a collaborative sense of community among the youth.

At the **Headwaters Science Center** in Bemidji, MN, ten native youth from three local Boys and Girls Clubs (Bemidji, Cass Lake and Red Lake Nation) were trained to lead activities with younger children, with activities two to six times per month throughout the school year. The project was designed to increase collaboration between the science center and the local Boys and Girls Clubs.

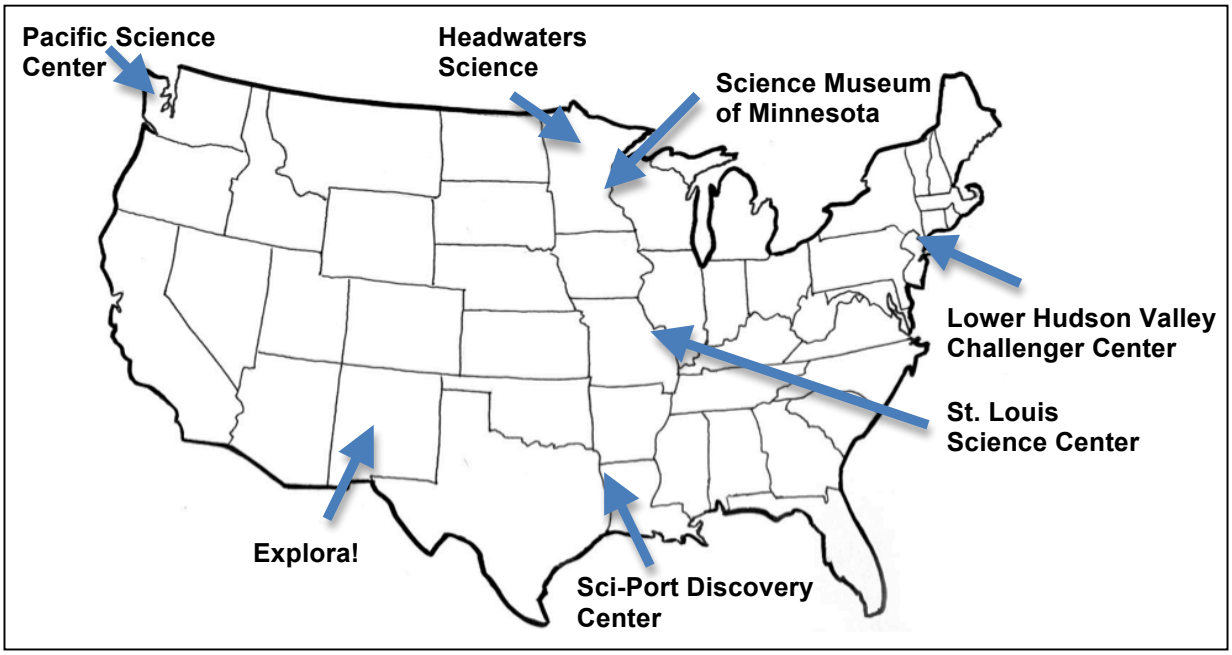
The **Lower Hudson Valley Challenger Center** in Airmont, NY partnered with schools in their area to sponsor 5 middle and 10 high school students in robotics teams for the First Lego League. Strengthening the partnership with the school district was a major goal of the project, though challenges did arise. Unfortunately, teens did not qualify to compete in League events their first year. The youth were engaged in the activities and were able to compete at a local tournament at the Challenger Center with plans to continue the program next year.

At the **Pacific Science Center** in Seattle, WA, two teens were hired from their Discovery Corps youth program to deliver activities in two local Atlantic Street Center sites. The teens acted as co-facilitators and role models to create a Science Day once a month at each location. This project was designed to strengthen the relationship among partners and provide an opportunity to expand the Discovery Corps program. Rather than a physical, permanent space for learning, the staff and youth focused on making any community space into a learning place for the inquiry-based activities they brought for the children. In mid-project, the community partner requested training for their staff instead of the Science Day activity. To strengthen the partnership by meeting community needs, Pacific Science Center agreed to the change.

The **Sci-Port Discovery Center** in Shreveport, LA partnered with a local school to focus on robotics using LEGO® Mindstorms® NXT® robot kits in their four-month program for thirteen 9th and 10th grade students at risk of dropping out of high school. One goal for the project was to create *learning places* within Sci-Port for longer engagement of visitors.

Each of these five Phase 2 Museums was brought on board as the Learning Places project began, with their involvement in the first three years limited to attending the Collaborative Design Team meetings in St. Louis. Thus, they had only one year, the last year of the project, to complete their mini-project.

Figure 4. Partner Museum Locations



FINDINGS

The following findings directly relate to the project goals above.

STEM UNDERSTANDING AND PROBLEM SOLVING BY CHILDREN

Project goals for children involved the Learning Places project were to (a) promote understanding of STEM concepts, (b) develop problem-solving capacity and engagement, and (c) develop passion for investigation and design, and thereby motivate further study of STEM subjects. To determine how well the project achieved these goals, a series of focus groups and observations of children in both cities were conducted.

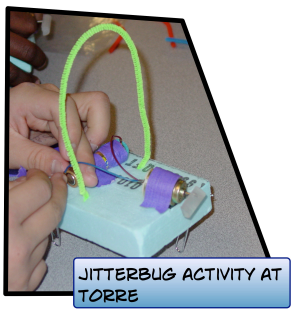
Focus changed mid-project from STEM content to STEM process.

During the project, key personnel decided that the focus should be on STEM process rather than content. Since the original project goals did not change, the evaluation explored understanding of STEM concepts *and* the acquisition of process skills by children and teens.

Children held a variety of interesting science conceptions.

Children were observed in *learning places* engaged in a variety of activities, including creation of Jitterbugs with electrical circuits, investigating marbles on tracks, creating shadows and mixing colored lights, magnifying letters through various means, growing plants, and exploring colors. Focus group interviews with children in St. Paul and more informal interviews with children in St. Louis found a variety of science conceptions held by the children.

In the second year of the project, only one Learning Place was completed, at Torre's Advantage Center. In a focus group after building jitterbugs (pictured) and working with motors and batteries, the children claimed the battery "stores energy from the sun" and "stores energy so this [his jitterbug motor] can run without electricity." They further explained, "Electricity gives you juice, it gives you juice to light; when the electricity runs out, the light runs out." When describing how the electricity moved in their jitterbugs, the children pointed to the battery with two fingers, one on each wire, and followed the wires to the motor. They all agreed that electricity moved from the battery up both wires at the same time to the motor (instead of in a circular motion).



JITTERBUG ACTIVITY AT TORRE

Children at Torre in Year 2 reported new understanding, though some misunderstanding continued.

This was a new experience for many of the children. One girl, age10-12 years old, said, “I learned more about electricity, because I never knew a battery could power electricity by itself. Well, I knew that, well I thought that something else, like you had to have a mechanical device, something else powered it to make the battery work, but right now the battery alone makes it work.” A fifth grade boy said he liked the activity because “when you get bored you can do this, and learn new skills; and when you grow up you can teach these to the kids and stuff. … I learned that if you put a battery right here and two wires right here and the thingy will move and if you take the wires out it won’t move. And the batteries are electricity to make it move.”

This broad spectrum of ideas about electricity and batteries was similar to the broad spectrum found at other sites in the following year. In the third year of the project, each site used different activities with the children, making comparison across sites difficult. However, comparisons regarding problem solving and investigation processes were made more interesting because of the diverse activities.

In St. Paul, children at the Sklyline Advantage Center engaged in Marble Run activities by creating tracks on a pegboard and rolling marbles down tracks and through loops. When asked to explain how marbles work, the children had these observations after only an hour with the materials:

- The fatter the marble the slower it goes
- The smaller the marble the lighter it is and the farther it goes
- The marble gets slower as it goes farther on the track
- When they tried to make the marble go on a second loop it wouldn’t go around the second loop because it was too slow
- If you put the two loops close together (almost side-by-side), however, the marble will jump from one loop to the other (they tried it six times and it always jumped over)
- Sometimes marbles jump off the tracks on the pegboard, but it is possible to figure out how to keep it from jumping off by moving the tracks


LEARNING PLACE AT SKYLINE

Children at the Cathedral Hill Advantage Center in St. Paul enjoyed Light Play activities, saying this was their favorite of all the *learning places* activities. One boy said the *learning places*

activities helped him with science at school because when he had to do experiments in small groups he used LP activities. Another said these activities "make your brain smarter." The children had experimented with the shadow box. When they moved objects away from the light, they noticed the objects' shadows got bigger and blurrier because "the distance of the reflection can't go that far."

Children gained experience with the tools of science in Year 3.

In St. Louis, teens engaged the children at the Girls, Inc. site in activities on magnification using droppers, glass slides and water. Small groups of one teen and several girls worked together, each group with their own way of doing the activity. Most of the girls were unfamiliar with droppers so teens helped them learn how to use it to get a drop of water on a glass slide to magnify letters on a newspaper. While there was no evidence that the girls were learning about magnification, it was clear that the girls were gaining important skills with measuring, recording data and using droppers.

YOUTH WITH CHILDREN AT GIRLS, INC.

At the Herbert Hoover location on Grand Avenue and at Gateway Homeless Shelter in St. Louis, children planted grass seeds and observed their growth under different conditions. One boy explained that plants get their nutrients from the sun and others continued to hold various misconceptions about plants.

Teens reflected on the activities after each session, and changed activities when needed.

After each session at a community center, teens in both cities reflected on the activities and discussed what to change or do differently the next time they did the activity. After a session at Herbert Hoover at Adams in St. Louis in which teens worked with children to make spinners, one teen admitted that he didn't think the girl he was partnered with "got what she was supposed to learn, " and then admitted that he didn't know what they were supposed to have learned either.

Children engaged in the process of science rather than deepening understand of content.

For children in Learning Places, there was little evidence of deepening their understanding of STEM concepts; however, it was clear that the children engaged in the process of science, often using new tools of science. They were eager to investigate new phenomena. While we found no firm evidence regarding their motivation for further study of STEM subjects, anecdotal evidence

suggested some children continued to work with the materials at home.

Self-Serve Learning

St. Paul teens found children needed teen or adult guidance and interaction rather than "self-serve" activities.

In St. Paul, teens began with an attempt to create activities that did not require teen or adult input, "self-serve" as they called it. The children continued to look to the teens for advice and encouragement even when the teens attempted a hands-off, observation role. Eventually, the teens decided to train the CommonBond staff and volunteers to work with the children to encourage the children to make predictions and try new inquiries, realizing the children needed the teen or adult interaction. Staff continued activities when teens weren't there.

St. Louis community center staff members relied on teens to lead activities.

In St. Louis, the teens developed activities that required their leadership and interaction with the children. Unfortunately, by having each teen work separately with a small group, children received various degrees of encouragement to make predictions or engage in new inquiries. This small group work also often left community center staff out of the activities. With limited training of staff on the activities the teens created, this also meant less likelihood of extended inquiry by the children or use of the *learning places* when the teens were not present.

STEM UNDERSTANDING AND PROBLEM SOLVING BY TEENAGERS

To gauge the understanding of the teens, the evaluation relied on observations, focus group interviews with all teens and interviews with a sample of teens from each city. As part of the interviews, teens were asked to engage with materials they had used during their work with the children, but to use the materials in new ways.

Changing Approaches to STEM Activities

Observations at the museums and in the community centers in St. Paul and St. Louis over the three years revealed changing approaches to STEM activities and understanding. In St. Louis, for example, STEM activities in the beginning of the project covered many topics with little depth. A City Technology led workshop covered "motion, direction, diameter, circumference, speed, torque, energy storage and conversion, the Law of Conservation of Energy, electric current, voltage, magnetic field and electromagnetism," according to the co-PI from City Technology. Staff-led activities covered fewer topics but at the same general level. It was not surprising that teens failed to gain deeper understanding of STEM concepts when covered in this manor.

In St. Paul, by contrast, teens spent longer with electrical circuits and other topics using inquiry-based curriculum. As teens began work on the design process, teens engaged in the long-term process of designing the space at Torre and the portable exhibits for the other three sites.

By year 3 in St. Louis with new staff, teens began to design longer-term investigations for the children with plants, and some teens engaged in their own investigations. n general, however, St. Louis STEM activities covered more topics in less depth than activities in St. Paul.

Interview Results From Color Activities

In the second year of Learning Places, teens in St. Louis answered interview questions about rivers while St. Paul teens answered questions about electrical circuits and energy. In the third year, St. Louis teens examined plants in the interviews and St. Paul teens addressed parachutes. In both cities in year three, teens explored colors with colored water and lights as they explored various combinations through the interview process. Each activity in the interview involved novel questions for the teens to examine.

Teens demonstrated solid problem-solving skills, though STEM concept understanding varied greatly.

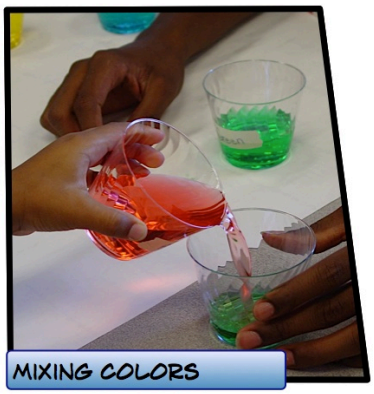
Responses from the teens ranged from accurate descriptions of concepts in the language of teens to some interesting alternative conceptions about rivers flowing backwards, switches powering light bulbs, plants getting their food from the soil, and light waves going through solid objects to create shadows. Even though the understanding of key STEM concepts varied greatly from teen to teen, almost all teens exhibited solid problem-solving skills and willingness to reason through the questions and challenges presented in the interviews.

Results from the questions on color provide an example of the interview process and results. Two distinct areas of investigation were involved, mixing colored water and combining colored lights. For each activity, teens from both cities were asked to predict what would happen, explain what did happen, and describe how they thought children in the community centers could approach a similar investigation. Mixing pigment, as in the colored water, and mixing colored lights produce different effects. Teens in St. Louis had mixed colored water with children in community centers, while St. Paul teens had worked with colored lights and visited the SMM exhibits using shadows and colored lights. The activities used in the interviews were chosen to see if the teens could use what they

knew about light and color to explain some of the different results that occurred in the activities.

Mixing Colored Water

After successfully predicting what would happen when blue and red water were combined or when yellow and blue water were combined, teens were then asked to predict what would result when the third color was added to the mixture (i.e., all three primary colors were combined). Only five of the eleven teens predicted they would get a dark color like brown or black.


MIXING COLORS

Reflecting Colors

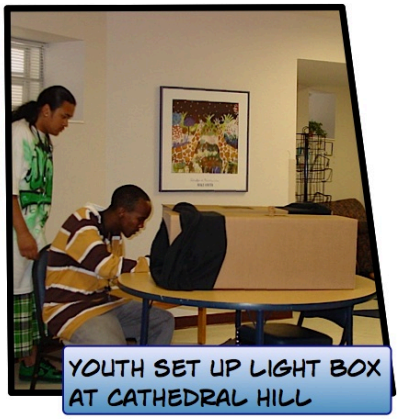
Building on the colored water activity, teens were asked what would happen if we shined a light into a clear plastic cup of blue water held over a white sheet of paper. Teens were asked to explain what was happening to the light and to described the path of the light. It was hoped that teens would trace the light through the cup to the paper and to their eyes with some description of reflection and absorption of light and colors. Only three teens (all male) described the light hitting the eye. Six teens described the light moving through the water and onto the paper. Two of those six said it then bounced off the paper; another said the light stayed on the paper; one said he wasn't sure where it went once it hit the paper; and two didn't comment beyond the light reaching the paper.

Teens had limited understanding of properties of light even after creating activities involving mixing colors.

Additional questions were asked to see what the teens understood about reflection, refraction and absorption of light. Most were not able to describe why the water appeared blue, though four males all described the idea of light as all colors and the water absorbing all colors except the blue. Only these four used the terms reflection and absorption, and all used them appropriately. One male used the term refraction and knew it had to do with light bending. This same teen explained that light was a particle and a wave.

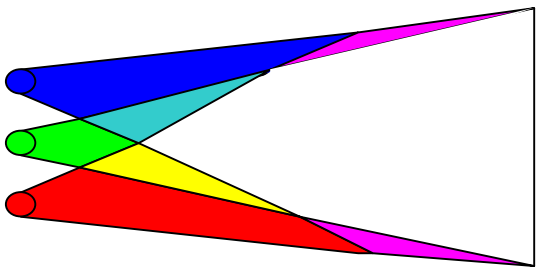
Colored Lights and Shadows

The next activity was similar in design to popular exhibits, including one at SMM, and the Exploratorium's Colored Shadow Science Snack. Three colored lights (red, green and blue) were used against a white board. Metal cans were used to focus the lights on the center of the board. Before turning on the lights, teens were asked to predict what color we would get if we combined all three colored lights by focusing them in the center of the board. Only three teens thought the result would be white. Five said the combination of lights would be brown or dark, like the colored water combination. Three did not have a prediction.



Once the lights were on, as in Figure 5 below, teens were asked to predict what would happen if we held an object in front of the lights.

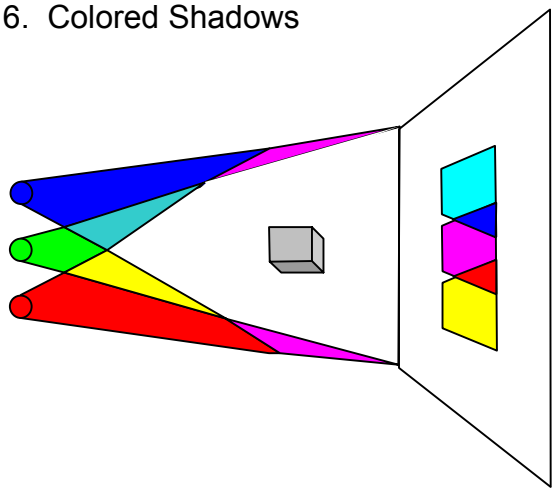
Figure 5. Lights on White Board



All predicted a shadow of some sort, but none were prepared for the three shadows that appeared as in Figure 6. Seven of the teens thought the red light produced the red shadow in the center (referring to either the magenta shadow in the center or the red shadow created by the over lap of yellow with magenta). One female and one male thought the red light produced the blue (actually cyan) shadow, which it did. The male explained this by describing how the object blocked the red light and let all the other colors through to create the blue shadow. Even when the red light was turned off or was the only light left on, the seven teens who thought the red light produced the red shadow held to that belief.

Teens struggled to apply their understanding of light to novel problems.

Figure 6. Colored Shadows



Teens were then asked to describe the path of the light from the red light bulb with varied results. Two said the light went to the object, to the board and then to the eye. One said it went to the object, to the board and then back to the light. One said the red light went through the object to the board. The most elaborate explanation included the idea that light could act was a particle or wave. It acted as a particle when the red light "refracted around the object" to create the red shadow. When it acted as a wave, the light "went through" the object, a finger at this point, to make the red shadow. One teen commented that you should use natural light with this sort of investigation since light bulbs have a yellow tint, something based on his experience with space design and lighting in the Learning Places project.

Teens were willing to reason through answers and try out different explanations.

As with the other interview questions, most teens were willing to reason through their answers and try out different explanations. If more time were available, it would have been interesting to allow the teens more time to explore the nature of the lights and shadows to see how they would investigate the phenomena and whether their ideas about them would change.

Teen STEM Understanding

If teens were given a test on content knowledge related to their LP activities, many would fail. Fortunately, passing a test on content knowledge was not the goal of Learning Places. The goal, however, was to deepen understanding of STEM concepts, including problem solving and creative design. It was hoped that this would allow teens to solve novel problems. Though not an explicit goal, it was also hoped that teens and children would not develop new misconceptions along the way and might even

confront misconceptions and develop new understanding more consistent with current science concepts.

Results indicated that teens developed problem solving and design skills, though continued to hold tight to misconceptions. In addition, it was clear that experiences of the teens impacted their understanding in ways not predicted. For example, St. Louis teens were given a demonstration of the stream table and water table at SLSC. From their stream table experiences, the teens' reasoning about dams and erosion during the interviews revealed the impact of that experience. Their descriptions and predictions matched that of the stream table, with houses falling into the river and the dam eventually collapsing as the water pushed against it. It was very likely that the teens had never seen the spillway on a dam, seen a power plant that produces hydroelectric power, or discussed with landowners the advantages and disadvantages of building a dam on a river near their property. Without additional experiences or understanding of dams, these teens built their concepts of dams based on the model where the dam always collapses.

The background experiences of the teens impacted their understanding of STEM concepts.

An additional goal for teens in the project was for the youth to begin to consider careers in STEM areas, particularly STEM education. Teens in Learning Places were exposed to a variety of careers that they would not have seen without Learning Places. However, teens who expressed an interest in STEM careers during Learning Places came into the project with that interest.

TEENS AS AGENTS OF CHANGE

A primary goal of Learning Places was for teens to develop self-images as agents of change with internal locus of control. The project leaders wanted teens to learn to make more informed choices, and then be motivated to advocate for those positions. Interviews and observations provided information to assess project goals related to teenagers; however, to further examine the impact of the Learning Places project on the participating teens' self-image, teens were given the Origin/Pawn Assessment. Results for each of these is described here.

Origin/Pawn Assessment

In this assessment, teens were asked to write five stories, which were then scored in each of six categories: goal setting, instrumental activity, reality perception, personal responsibility, self-confidence, and personal causation. These categories and a detailed description of the method (including inter-rater reliability) are discussed in detail in a separate report available upon request from this author.

deCharms' Origin Measure used a pre & post writing assessment to examine personal causation.

The origin/pawn measure was developed by Richard deCharms (1989) to gauge changes in experience of personal causation, defined as "doing something intentionally to produce change." deCharms uses the term *origin* to describe experiences accompanying personal causation. The assessment only scores for aspects of origin experiences. In addition, deCharms also refers to *pawn* experiences in which an individual does not experience herself as the origin of a change. In pawn experiences, goals are imposed by others, others determine the activity, or the individual reacts to a threat. To remind us of this duality of experiences, and because deCharms used it himself in later years, the term *Origin/Pawn Assessment* is used to refer to the measure and scoring system used in the Learning Places project.

Project leaders wanted to know if teens in the Learning Places program saw themselves as the cause of desired change (origins), and if after being in the program there was an enhanced sense of personal causation. To find out, teens were given the assessment soon after beginning the program and near the end.

Mean scores went up in St. Paul while scores in St. Louis showed no significant change.

While 55 Learning Places teens took the assessment, only 17 took both the pre and the post assessment. Results were very different in St. Paul than in St. Louis. In general, means of scores were higher for the St. Paul post-assessments than for the pre-assessments, while St. Louis post-assessment scores stayed relatively steady or were lower.

When examining the data from the 17 teens who took both the pre and the post assessments (matched pairs), there were no significant differences between pre and post assessment scores in St. Louis for any of the six categories or for the total scores. St. Paul teens' means were significantly higher on the post assessment than on the pre-assessment for Reality Perception and their Total scores, with scores higher on the post-assessment than on the pre-assessment for five of the six categories.

Program impact was different in each city, yet the Origin Measure results could not be used to draw additional conclusions.

With St. Paul's post-assessment means of the scores higher than pre-assessment means, and with St. Louis teens' post-assessment means of the scores lower than pre-assessment means in four of the six categories, we could say the impact was different at the two sites. Additional data from interviews and observations were needed before jumping to the conclusion that the St. Paul-based Learning Places program made more of a positive impact than the St. Louis program on the teens' sense of personal causation and originship.

A closer examination of the pre and post-assessments on the 17 matched pairs of data indicated that percent of time spent in Learning Places in relation to time spent in the youth program overall, amount of time spent in the program (less than or greater than 250 hours), and time between the assessments did not appear to impact scores on the two measures.

Of concern were six of the 12 St. Louis teens with negative gain scores, defined as the difference between post-assessment and pre-assessment scores. While all St. Paul teens had positive gains, four St. Louis teens' scores were 3, 4 and even 8 points lower on the post-assessment than on the pre-assessment.

Observation and Interview Results

Staff members affected youth sense of agency.

As has been noted, the two pilot museums each employed two different program managers along with other youth development and science education staffs. While this appeared to have no significant effect on teens' origin/pawn scores, the staffs did appear to affect the youths' sense of agency. From the staff changes, four distinct facilitation styles emerged from the staffs as summarized in the table below.

Table 1. Facilitation styles in St. Louis and St. Paul

	St. Louis	St. Paul
	Generalist	Developer
Years 1-2	*Year 1*: One manager and one intern *Year 2*: same manager with support from YES staff *Year 2 Summer*: science expert joins team • Focused on activities for children at five sites • Used icebreakers with teens regularly, most were in form of competitions • Chose activities from various sources for teens to lead with children • Adult and teen staff did not always take time to run through activities before facilitating them • Teens occasionally evaluated activities	*Year 1*: One manager and one CommonBond staff member *Year 2*, *first half*: same manager and CommonBond staff member • Focused on prototype of space and activities at Torre • Used check-in with teens regularly • Suggested activities for teens to lead from Design It curriculum and let teens decide what to lead with children • Teens tested activities before leading them with children • Teens regularly evaluated in depth, and teens changed activities and space based on evaluation

	Designer	Laissez-Faire
Years 2-3	*Year 2 end of summer*: New manager joined science expert *Year 3*: Same manager and science expert most of year • Focused on physical spaces for 5 sites at first and then the activities to use in those spaces • Used icebreakers with teens occasionally, most were team building or problem solving • Suggested activities from various sources for teens to lead with children, though teens also developed activities • Teens generally tested activities before leading them with children • Teens debriefed activities verbally and on blogs, though seldom changed activities based on comments	*Year 2, second half*: New manager hired *Year 2 Summer*: science expert hired *Year 3*: CommonBond staff change • Focused on activities and portable *learning places* for three sites • Used check in with teens occasionally, though CommonBond staff member continued to meet periodically with teens individually • Let teens choose activities from PIE curriculum • Teens tested activities before leading them with children • Teens continued to evaluate activities and spaces and make necessary changes

To simplify the discussion of the analysis and findings from observation and interview data related to teen agency, these four types of facilitation styles are called the Generalist, Developer, Designer and Laissez-Faire. While most results occurred for all four styles, others occurred with only one or two styles. These findings are described below.

Teens developed comfort with adults resulting in confidence in communication with program staff, community partners and community leaders.

Teens developed comfort with all four program managers. They engaged in banter with the Generalist, friendly joking with the Developer, friendly debate with the Designer, and a give-and-take with the Laissez-Faire manager. Additional staff helped create camaraderie, each with their own style. Youth expressed confidence in their interactions with all program staff.

CommonBond created an additional position to support the program manager, a liaison between CBC and SMM. This staff member worked directly with the youth and their parents in St. Paul, in addition to working the program manager to support the Learning Places activities.

Each program manager supported teen interactions with the community partners' staff differently. In St. Paul, the Developer team of program manager and CommonBond staff member, supported LP teens in presenting plans to CommonBond managers and local advisors for feedback. Teens felt like their

ideas were taken seriously as they co-created the first prototype learning place. The Laissez-Faire team carried on the same tradition of presentations and receiving feedback for the remaining three St. Paul *learning places*, though they no longer involved advisors. This same team supported the youth in training the CommonBond staff to use the activities and materials in the *learning places*. While the Developer style guided the teens through the process, the teens took responsibility under the Laissez-Faire style.

LEARNING PLACES PROTOTYPE AT TORRE

In St. Louis, the Generalist program manager handled most of the conversations with the community partners herself regarding schedules, spaces, activities and content. The teens worked with community partner staff at the sites as they delivered activities. Under the Designer staff later in the project, the teens prepared and rehearsed presentations for each community partner to describe the design of the learning place to go into their site.

In both cities, teens were introduced to community leaders, including the museum presidents, business leaders, and leaders of community organizations. All four styles of facilitation included this aspect. When teens in St. Paul were asked to attend the CommonBond gala to receive the Housing Heroes Award for their work in the Advantage Centers, this was taken to a new level and clearly gave the teens a big boost of self-confidence and pride.

In summary, all four facilitation styles supported teens in building the confidence to interact comfortably with adults. The impact appeared greater in St. Paul where LP teens met with CommonBond staff more frequently in the design process, delivered more professional development of staff, and attended the CommonBond gala.

Teens developed social skills and confidence in peer interactions.

Many teens were shy, angry or withdrawn when they entered the program. In focus groups and interviews, they described how the program helped them learn to speak to their peers and develop appropriate social skills. Observations found many youth to change over time becoming more engaged and developing more confidence. One St. Louis youth said she realized she was a negative person, but the positive energy of another youth was "rubbing off on her." One youth in St. Paul made remarkable growth.

WORKING TOGETHER THE AT YOUTH SUMMIT

His program manager noted in an interview that he was actually carrying one project in Year 2 when he would have let others do all the work in the first year. She went on to say that it took him a year to get comfortable with the program and peers, yet under different circumstances or in other youth programs he might have been removed from the program before that. Another St. Paul youth described how in talking with others he now listened to "the whole thing they say."

While changes differed from teen to teen, most developed their social skills and gained confidence in peer interaction. There was one challenging period, however, under the Generalist facilitation style. The competitive nature of the teens' activities led to anger and frustration on the part of youth and adult staff in St. Louis. Icebreakers were designed to be teambuilding activities, however, the staff presented them as competitions. Pitting one group of LP teens against another exaggerated negative emotions and mistrust before youth were able to build trust and confidence in their relationships with each other. The staff appeared to lack the training and experience needed to facilitate teambuilding activities.

Teens developed comfort with people different from themselves.

This statement holds true for all St. Paul teens under both program managers, but no evidence was found for this in St. Louis. In St. Louis, most youth and many staff were very similar in background, race and ethnicity. In St. Paul, however, the youth came from four different public housing sites, several different ethnicities and several different religions. Their parents spoke different languages, many coming to this country at different times and under different circumstances. In focus groups and interviews, the teens described how they benefited from meeting and working with people different from themselves. One teen said working with people of other races made him "want to get more friends at school from different backgrounds" and Learning Places made this easier.

To develop this comfort with others, the Developer facilitation style used a check-in process at the beginning of each session in which youth and staff would rate themselves at a level from 1-10 with 10 as feeling great and having a great day and a one as having the worst day possible. The program manager and CBC Liaison would rate themselves and model the process by describing why they chose the number they did in terms of interactions with others at home and work. All teens were supported in this process. The process was mechanical or dropped for a period of time under the Laissez-Faire style, but by then the youth had a sense of being a team that supported each other. With both facilitation styles, youth were engaged in work that brought them together in ways in which they had to work together and rely on each other.

Through teaching younger children, teens developed social skills and saw how they could impact the lives of children.

While all teens developed social skills through their interactions with younger children, only data from St. Paul indicated that leading activities with children gave the teens a sense of agency through impacting the children. St. Paul youth explained how it was cool to create activities for children that were fun for the children.


ENGAGING CHILDREN IN LEARNING

In St. Louis with the Generalist style, teens often led activities they had not yet tried themselves. Rather than leading the activities with peers first, as was done in St. Paul or later in St. Louis, the teens in the first and second summers would often lead activities from having read about them or discussed them without trying them. Youth sometimes questioned whether the children were learning anything. One hypothesis arising from the data is that running through the activities with peers first leads to greater success in leading the activities with children which leads to a greater sense of agency on the part of the teens.

While evidence for an increased sense of agency through leading activities with children was found in St. Paul and counter evidence was found under the Generalist, evidence was missing under the Designer style of facilitation. The youth may have developed a sense of agency through working with the children, though this was not observed directly or discussed in the focus groups or interviews.

Opportunities to travel and meet important people built self-esteem.

Teens in both cities had opportunities to travel and meet community and business leaders throughout the three years of teen involvement. Some teens were able to travel to a CDT meeting or Youth Summit in another city. All took field trips to area businesses. All youth met the president of their museum. St. Louis teens were impressed to meet the president of Visa and leading architects. St. Paul teens were impressed by the members of the St. Paul Learning Places advisory board and the leaders attending the CommonBond Communities Gala.


YOUTH VISIT COCKPIT ON TRIP TO MN

One youth was so impressed by Hector Escalera, the speaker at the first Collaborative Design Team meeting, that she decided to be a motivational speaker like him, a goal that continued through to her college choices.

Knowing STEM content built status with peers and self-confidence in school.

St. Paul teens throughout the project reported that knowing the STEM content of activities they participated in and led impacted their lives. They were more comfortable and confident in their science classes at school, gained status among their peers for their knowledge, and one even improved her ability to write papers in school because she learned to "break things down." St. Louis teens did not report similar program benefits.

SETTING UP LIGHT PLAY AT CATHEDRAL HILL

Opportunities to speak publicly to groups of children, peers and adults built confidence.

This finding held true for all but the Generalist. With the three other facilitation styles, teens practiced speaking to groups and then were able to successfully apply those skills. In the third year in St. Louis, teens used video cameras to practice and record presentations later given to community partners. In St. Paul, youth practiced presentations with their ideas on the prototypes and professional development of CommonBond staffs.

ST. PAUL YOUTH LEAD PD FOR STAFF

The Generalist in St. Louis created an excellent opportunity for teens to practice public speaking when she had the teens create and act out a play for general science center audiences. While this was outside the scope of the Learning Places project, it was an opportunity for growth. Unfortunately, the teens were not coached for success. Teens mumbled lines, looked away from the audience while speaking, and did not take the task seriously. Rather than use the performances for reflection and improvement, the Generalist gave some praise and moved on. The performances were dropped in subsequent years. Rather than an opportunity for confidence building, the plays created the opposite effect on many teens.

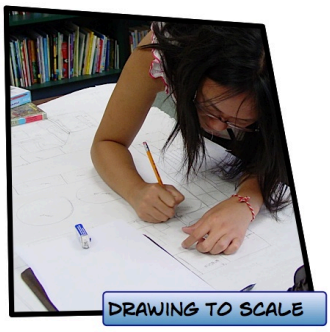
Public praise and criticism impacted self-image.

Most Learning Places staff and consultants praised teens in public at one time or another, some far more often than others. Teens responded very positively to sincere praise, though a few would occasionally act as if it was no big deal while still sitting or walking a little taller. Praise occurred as staff worked directly with the teens and in more public settings like the CDT meetings. Staff members at SMM were the most consistent in giving public praise with the exception of the Laissez-Faire program manager, who acknowledged her tendency to publicly criticize teens and made an effort to change. The Generalist program manager joked with teens in ways that some took as criticism. Teens responded to such criticism with less effort and spoke unfavorably of the staff member to other teens immediately after the criticism, though teens continued to speak favorably of the staff member overall.

Self-image and sense of agency improved with real, meaningful work.

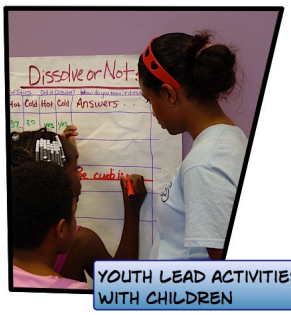
The nature of creating physical *learning places* and activities for children provided real, meaningful work for the youth. They spoke in blogs, focus groups and interviews of how important they felt their work was. One St. Paul teen blogged, “I feel like a professional architect.”

As a counter example, however, in the first year under the Generalist style of facilitation, the teens engaged in leading children in activities in the same ways they always had. The Learning Places teens were doing what other YES teens were doing rather than designing new spaces or creating longer inquiry activities. One hypothesis to emerge is that doing what has always been done does not lead to improved sense of agency.


DRAWING TO SCALE

When teens acted independently while staff guided, teens developed leadership skills.

The Developer and Designer guided the teens by providing a clear framework and expectations within which teens took their own initiative. Under these circumstances, teens were successful or were supported to learn from unsuccessful experiences. With the Laissez-Faire program manager taking a hands-off approach in general, the teens



YOUTH LEAD ACTIVITIES WITH CHILDREN

continued their work from under the Developer's guidance and were supported by many other SMM and CBC staff to continue to develop their leadership skills. The Generalist program manager was directive in her approach with the teens, telling teens to take their own initiative without providing the guidance to succeed or actually develop leadership skills.

When teens succeeded in facing challenges and solving meaningful problems, they were empowered.

The teens expressed a sense of accomplishment and pride when solving meaningful problems and mastering challenges. Examples of challenges included designing stream tables with the Generalist, designing the Torre learning place with the Developer, completing the installations of the *learning places* with the Laissez-Faire manager, and creating activities and spaces with the Designer manager.

TAKING MEASUREMENTS AT SKYLINE

A safe, supportive, non-judging community had a positive effect on self-esteem, while the opposite also held true.

St. Paul teens were clear under the leadership of the Developer style that the YSC provided a safe, supportive, non-judging community that was critical to the success of the Learning Places project and any attempts to replicate it. The neutral territory allowed youth to take risks and try on multiple roles. One YSC staff member said all youth should feel like celebrities when they walk in the door, and the behavior of the staff matched this sentiment. During the Laissez-Faire group, counter examples included correcting teens in front of other teens and adults by the program manager. Other staff at the time, continued to provide the positive support as a balance.

In St. Louis, the Generalist program manager set up competitive activities that set teens against teens. When teens put each other down, the staff did nothing to stop the behavior, allowing a community in which judgment pervaded and risk taking was discouraged. With the Designer staff by contrast, youth were supported when they took risks, and respect for each other was encouraged.

When youth expressed feeling safe and supported by staff, they were more engaged in the program and activities. They spoke more confidently in their decisions and were more likely to try new things. When youth faced criticism, they often withdrew and, not surprisingly, tended to do the minimum of what was expected of them.

Teens developed a sense of agency when they knew their ideas mattered.

Teens in both cities reported that adults in the Learning Places project took their ideas seriously. It was clear that this instilled a sense of pride. In St. Paul, teens knew the CommonBond staff listened to their ideas through their many meetings to finalize plans for the *learning places*. Museum staff let them create the designs and change the designs based on teens' ideas. In St. Louis, teens reported that staff changed the food and other aspects of the program based on teen ideas.

Debriefing, evaluating and reflecting upon their work helped teens see the impact of their actions and thus develop a sense of agency.

Teens in both cities evaluated their activities and spaces. Through blogging, youth reflected on the *learning places* and the program as a whole. Under all facilitation styles, teens debriefed activities after working with the children at the sites. In St. Paul, this took the form of debriefing conversations. In St. Louis, the Generalist used short conversations, though these rarely went in depth. The Designer staff used several techniques including reflection on photos from the activities, recording videos of their reflections, and guided reflection on a specific topic like the process skills they used that day. Each time the teens debriefed, evaluated or reflected on an activity or design and made a change based on their observations, the teens saw the benefit of reflection and the impact of their actions as they noticed improvements in the project.


YOUTH DEBRIEF ACTIVITIES AT GIRLS INC.

Blog and Journal Analysis

In the planning stages of the Learning Places project it was expected that teens at the St. Louis Science Center and Science Museum of Minnesota would write in journals on a regular basis to reflect on the project and to communicate with staff about their lives both in and out of the project. Once the project was underway, journals were often replaced by the more public blog venue as a tool for project reflection and communication, though hand written journals were still used for more personal reflection. Analysis of the journals and blogs of Learning Places teens explored changes over time in teens' entries and addressed the following questions.

- How often and when were blogs and journals used and how did that relate to the staff present?
- How did blogs change over time in Learning Places?

- Did blogging and the use of forums build an online learning community?
- What can we learn about STEM (Science, Technology, Engineering and Mathematics) content understanding from teen blogs? (including videos, photos, notes, comments)
- How did teens understand inquiry and investigation?
- How far did teens come since the beginning of the project? How did they change? How did they grow?

To answer these questions, case studies of eight teens who were in the project from the start through the summer of 2008 and frequency data from all teens in the project were utilized. Sample journal entries and blogs from teens were collected and copied for later analysis based on dates of observations, allowing for later links among journal entries, blogs and observations. A detailed analysis of this data was provided to project leadership. See Table 2 for dates sampled.

Table 2. Dates for sampling journal and blog entries by museum.

Museum	Fall 2005	Spring 2006	Summer 2006	Fall 2006	Spring 2007	Summer 2007	Fall 2007	Spring 2008	Summer/ Fall 2008
SLSC	Nov 12	May 6		Nov 4	Mar 17	Jun 28	Nov 3	Apr 5	Jul 2
SMM		Apr 12	Aug 8	Nov 29	Mar 10	Jun 25		Apr 9	Sept 16

Blogs allowed for comments, photos, videos and links. Journal entries occasionally contained comments from museum educators. All were included in the content analysis. Not included were any journal entries teens wanted kept private by folding over a page or stapling it closed.

Teens' journal entries and blog posts and the museum educator's comments to teens varied greatly throughout the project. As educators changed, so did the frequency of teens' journaling and blogging. The journaling and blogging by teens appeared related to their supervisor's comfort and interest level as educators modeled the practice and set aside time (or didn't) for writing. When museum educators commented on teens' blogs and journals, they offered encouragement, though each educator approached commenting differently. The quantity of comments by museum educators appeared to be related to the value they placed on providing personal, written feedback.

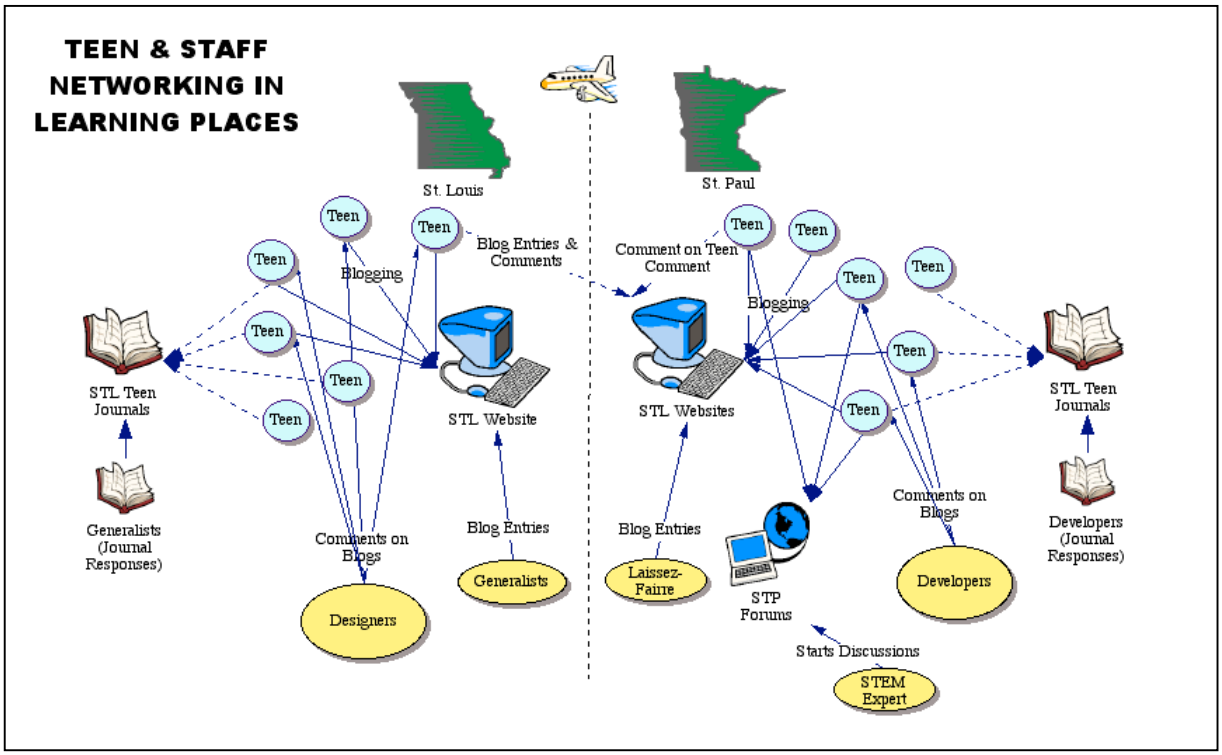
Blogs and journals played different roles and were used simultaneously. Journaling gave way to blogs as a form of encouraging teens to share thoughts on their activities once blogs were established and teens were given time and access. Journals came back later in the project to fill their own niche as a more private form of communication between individual teens and their supervisors. (See Appendix D for details on the various project websites and their uses.)

The level of detail written by teens increased over time, though appeared related to the supervisor present. The teens' ability to reflect on their activities and

interactions with staff and children improved over time. The comfort of the teens in sharing their views of the project, their supervisors and the children in writing and in public online spaces increased throughout the project.

Content analysis revealed two separate online communities as seen in Figure 7.

Figure 7.



Two separate online communities emerged among teens in St. Louis and St. Paul.

Teens wrote in journals and blogged within their own Learning Places team in their own city. Supervisors commented directly to teens in their journals and posted their own staff weblogs. Museum educators commented on teen blogs, and St. Paul educators initiated forum discussions by posting questions. Only once did teens from St. Louis blog on the St. Paul website, and only that one time did St. Paul teens comment back. Thus, two separate online communities existed.

Case studies of teens' journals and blogs did not provide evidence of understanding STEM concepts or processes. However, it was clear from the data that teens were adopting the language used by the staff. Teens appropriately used terms like inquiry, artifact and prototype. One example comes from a St. Louis teen who rarely blogged.

Figure 6.

INQUIRY
Submitted by [Teen 4] on Sat, 01/26/2008 - 2:01pm. Learning Places
Hi, how are you guys doing? Me i'm fine. Today in learnig places we talked about inquiry. One of the topics of inquiry i learned is that we should encourage the kids to answer and ask questions. We also learned how to start and to end questions

Even though St. Paul teens responded to direct questions about STEM activities posted on forums by the local science education expert, responses by the teens did not reveal the level of teens' understanding of STEM concepts.

Results from the case studies provided evidence of teen growth. Of the six areas of the Secretary's Commission on Achieving Necessary Skills (SCANS) thinking skills (creative thinking, decision making, problem solving, seeing things in the mind's eye, knowing how to learn and reasoning), teens exhibited decision-making most often with occasional examples of problem solving and creative thinking. Teens reported on decisions made in determining activities for the children and in guiding the program.

Teens exhibited decision-making, positive self-esteem and more through their blogs and journals.

The blogs and journals sampled for the case studies provided general examples of responsibility, sociability, self-management, self-esteem, and integrity, though examples of positive self-esteem and sociability were the most prevalent. Through their writings, teens shared their beliefs of their own self-worth, demonstrated empathy toward the children in the community programs, and provided examples of their adaptability in modifying activities and designs.

Blogs enabled consultants and staff to keep up with the work of the teens.

One of the greatest benefits of the blogs and forums was to consultants and staff. Consultants begged for blogs at first to learn what teens were doing in each city since they were not able to visit the sites often enough to follow their progress. When teens finally started to blog regularly, everyone benefited. Later blogs included photos and videos to provide even more detail.

Though the original proposal and plan called for youth journal writing rather than blogging, the blogs greatly improved the communication with staff and consultants across sites. Even though there was never a single youth website to create an online community of learners among teens, the blogs of the museum educators and teens supported the project in meaningful ways. Even though the teens' blogs and forums missed opportunities for

creating dialog and meaningful give and take, they created opportunities for dialog among key project personnel. Overall, the venture into blogging by Learning Places youth, museum educators and consultants created a meaningful learning experience and foundation for future work.

Connections

The youth development literature identifies characteristics of successful youth programs that are consistent with the Learning Places characteristics above (Hall, Isreal & Shortt, 2004, and Koke & Dierking, 2007). Examples include:

- Supportive relationships between and among youth and adults
- Youth involvement in decision-making and program design
- Work or service that is meaningful to the youth
- Partnership with community-based organizations and connections to the youths' communities
- Opportunities to interact with local business and community leaders
- Youth are introduced to the world outside their local neighborhood
- Teens gain sense of independence, particularly financial independence through wages or stipend

While consistent with this literature, the findings above add detail and elements for future program managers and researchers to consider.

In Learning Places, relationships between youth and adults were supportive. When educators praised teens' work in public, the teens put forth more effort and took their work more seriously. When educators criticized teens in public, effort and self-esteem suffered. When educators took a serious interest in the lives and work of the teens through check-ins, comments on blogs and individual conversations, the youth were more engaged and self-esteem appeared to increase. While these are predicted by the literature, we also found when one program manager used competitive activities with St. Louis teens, trust among the teens broke down and youth were less engaged and were less likely to take initiative or leadership roles.

Team building activities presented as competitions broke down trust and engagement.

Greater involvement in decision making in St. Paul may have led to higher Origin/Pawn scores and sense of personal causation than in St. Louis.

LP youth were heavily involved in decision-making and program design in terms of the *learning places* at the community sites, as evidenced by the blog analysis, observations and interviews. This high degree of involvement in meaningful work was central to the success of the project and to the agency of the teens. Involvement in decision-making was at a higher level in St. Paul, perhaps resulting in the more positive results on the Origin/Pawn assessment in St. Paul.

The involvement of the teens from the communities of the children added great value to the experiences of the children. At the same time, the community connections added meaning to the teens' work. Teens' blogs showed empathy for the children and a desire to make a difference in the children's lives.

Through Learning Places the teens were exposed to new aspects of their own communities and to the world at large. As they interacted with staff and children at community centers beyond their own community center, they saw the differences and similarities while developing an appreciation for such diversity. As they met with community and business leaders, as they traveled to new places, and as they experienced the world beyond their local communities, they expressed amazement and pride at the national impact their work would have.

The pay got teens in the door, but the program kept them engaged.

While teens readily admitted they came to the youth program largely because of the pay (in addition to the reputation of the museums and their programs), throughout the project the nature of the work and experiences they had were much more important to the teens. Consistent with other youth programs, the pay got them in the door but the work itself and the relationships they created were what kept them in the program.

MUSEUM STAFF TRAINING AND COLLABORATION

As described above, each program manager came to the project with a strong background in youth development; however, each came with a different comfort level with STEM education, with a different understanding of inquiry, and with a different connection with community partners.

STEM Comfort

With support by City Technology and later by local STEM education experts, museum educators went beyond their comfort zones when working with the teens on STEM concepts. For example, the Generalist worked with live animals even though she was afraid to touch most of them.

Program manager emphasis on STEM learning was directly related to their own comfort with STEM content.

Even with this support and the professional development offered by the project in inquiry and science education, the program managers' emphases on STEM learning was directly related to their comfort levels. Though they covered content outside their comfort zones, they stayed within comfort zones when it came to STEM education. The Developer had used the Center for Science Education's Design It curriculum (http://cse.edc.org/curriculum/designit/) with teens in the past and engaged LP teens in discussion and reflection related to the STEM concepts of the activities they explored. The Designer museum educators had strong backgrounds in biology and physical science so provided details on the content, even though more directive than inquiry-based. The Generalist program manager was uncomfortable with much of the STEM content and led activities without reflection or emphasis on the STEM, instead, focusing on the social or artistic features of the activities. The Laissez-Faire program manager left the STEM content to the local STEM experts and took a hands-off approach to the STEM activities of the teens, focusing instead on the relationship with the community partners.

Since the Generalist program manager lacked the strong STEM background and local STEM experts weren't on board yet, she was the most likely to develop "lethal mutations" of STEM activities. Brown and Campione (1996) identified the process of lethal mutation as when an enacted activity differs from the originator's design in a way that undermines the learning goals of the activity.

An example of a lethal mutation occurred with an activity from the Outdoor Biology Instructional Strategies (OBIS) curriculum from the Lawrence Hall of Science. In the classic Food Chain Game from OBIS, children take on roles of three different animals to learn about energy flow through a food chain. The Generalist knew of the game from having used it in previous YES activities and having played it at least once before. Only a couple of LP teens had played the game before and the version they played had been adapted from the OBIS design. The rest of the LP teens never played the game before taking it to the community center. By the time the game was played with the children, there was no energy flow involved and the game became a game of tag with a few children wearing the nametags of animals that teens had brought. There was no wrap-up of the game or mention of food chains or other STEM concepts.

The Learning Places goal for Youth Program Staff at SLSC and SMM states, in part, that staffs will "develop intention and capacity to modify existing programs for emphasis on specific STEM learning objectives." The intention and capacity to modify existing programs was directly related to museum educators' comfort levels. No new program focus on STEM learning objectives was observed. There was, however, a change in emphasis on inquiry related to educator professional development.

Inquiry

Engaging teens in inquiry-based activities and training teens to lead inquiry-based activities required different skills and different preparation of staffs.

There is a difference between understanding inquiry and training others to lead inquiry-based activities. While all museum educators had a general understanding of inquiry, not all could effectively train the LP teens to lead inquiry-based activities with children or design inquiry-based activities for the *learning places* at the community sites.

For example, the Developer program manager had worked with inquiry-based curriculum and attended related professional development to the extent that she was able to train the teens in leading the Jitterbug activity at the Torre Advantage Center in a way that allowed children to try different designs. At the same time, the Generalist program manager had attended the Exploratorium's Institute for Inquiry (IFI) several years prior, yet had no experience training others and had the LP teens leading short activities without inquiry or investigation. In neither case did their work with the City Technology materials or workshops seem to make a difference in their approach.

Professional development did make a difference, however, with the Designer and Laissez-Faire educators. The St. Louis Designer-style educators attended workshops by Rebecca Dyasi, and at about the same time, the program manager attended IFI and the science education expert attended a workshop at the Lawrence Hall of Science. These educators changed their approach to inquiry with the teens and encouraged the teens to engage the children in long-term inquiry projects, such as those focused on plant growth. The St. Paul educators attended PIE (Playful Invention and Exploration; PIEnetwork.org) professional development and began using PIE materials and activities with a marked change toward more sustained inquiry for the children in the CommonBond sites. The St. Paul teens had approached the design of the *learning places* as a sustained inquiry project since they began with the Developer. The change was in how they approached their work with the children and with the CommonBond staff at the sites.

Community Collaboration

A second goal for Youth Program Staff at SLSC and SMM was to "develop strategies for collaborative design with community organizations." Each site developed strategies specific to their museum and community needs. These strategies are described in the narrative record on the LP website (www.smm.org/learningplaces).

One successful aspect of the collaboration at the local level in St. Paul was the group of local advisors. These individuals met with Learning Places teens to provide feedback on designs, helped provide materials for the *learning places*, and supported the Youth Summit. Unfortunately, as museum educators changed, this group ceased to meet.

Another successful and critical aspect in St. Paul was the role of the Liaison between CommonBond and SMM. The CBC Liaison met individually with teens and their parents throughout the project and took action when needed to ensure each teen was as successful as possible.

In St. Louis, the local collaboration with an architect at Fox Associates provided the teens with design experience as they created their *learning places*. Collaboration with a local technical school, Ranken Technical College, provided some of the materials for the *learning places* such as the large protractor in a math area.

CLOCK & PROTRACTOR AT GIRLS INC.

INCREASED CAPACITY AND INTEREST IN COLLABORATION BY MUSEUM EDUCATORS

The Learning Places goals for museum educators and administrators outside of the Learning Places project were to "increase capacity and interest in engaging with more diverse audiences," and to "institutionalize collaborations initiated by the project." Since surveys were never returned and survey data were not available, there was no evidence to determine a change in capacity, interest or actual audience, though anecdotal evidence suggested SMM and SLSC audiences continued to diversify. This may or may not have had any direct relationship with Learning Places.

As the project ended in both cities, there was a clear effort to institutionalize the collaborations. In St. Paul, the relationship

Both pilot cities institutionalized the collaborations.

between SMM and CBC continued to grow. Museum educators continued to work with CommonBond to train and support AmeriCorps staff to develop and lead STEM activities with children at the CommonBond Advantage Centers. In St. Louis, YES staff members continued to offer professional development workshops to staff at community organizations, and measures were underway to further develop physical *learning places* for different sites, including within the museum itself.

By the end of the Learning Places grant, both museums were actively seeking new funding sources to continue to build on the successes of Learning Places with their community partners.

AFTERSCHOOL STAFF TRAINING AND TURNOVER

The community partners recognized regular turnover of afterschool and summer program educators as an issue. For example, CommonBond hired AmeriCorps staff with the understanding that they stay one or two years and move on. Knowing this provided the basis for training in St. Paul.

CommonBond and SMM created training for AmeriCorps staff to continue STEM activities with children after LP funding ended.

SMM teen and adult museum educators created the motivation for CommonBond to offer STEM opportunities for their children through the *learning places* at the four sites. CommonBond staff members were invited to participate in PIE workshops and attended professional development workshops led by LP teens to increase their capacity for STEM education at their Advantage Centers. Knowing the teens' role in the project was coming to an end, the partners created the opportunity for AmeriCorps staff to train and continue the work of the teens. The collaboration was meeting the needs of CommonBond, needs created by motivating them to offer STEM opportunities to children.

In St. Louis, community partners had the motivation to offer STEM activities before the Learning Places project began due to the engagement of YES program youth in the past. During Learning Places, the partners continued to rely on the teens to provide activities and provide expertise rather than taking on that role themselves. The Learning Places program offered five sites the opportunity to explore new ways to offer STEM engagement and to collaborate. However, after *learning places* were created, there remained a strong tendency by the community centers to return to the same way they had always worked together, with SLSC providing the expertise, activities and facilitators.

COMMUNICATION AND COLLABORATION AT THE NATIONAL LEVEL

Learning Places adopted new technologies as they emerged, technologies that offered solutions and challenges.

Communication at the national level was complex with multiple partners in multiple sites. Technology offered potential solutions yet often created new challenges along the way. The national collaboration raised many new issues and debates, including debates on theory versus practice, big ideas in science, and the idea of rich experiences.

At the first planning meeting in 2005, partners were given the Wilder Collaboration Factors Inventory (Mattessich, Murray-Close & Monsey, 2001) to assess and guide the effectiveness of the project. Results were presented to the principal investigators to guide communication and collaboration. The strengths of the project at that point, and throughout the project, were: Mutual respect, understanding and trust; Members see collaboration as in their self-interest; Unique purpose; and Skilled leadership. Two factors were concerns: Development of clear roles and policy guidelines; and Multiple layers of participation. These continued as concerns until after the summit in January 2007, when they were finally and effectively addressed with the help of an outside facilitator.

Cross-site Communication and Technology

In this complex project, communication occurred as adult staff worked with teens, teen staff worked with younger children and adult staff in community centers, museum educators and community center staff communicated, and project staff from the two project museums worked with the five new Phase 2 Museums. Various forms of technology were used for communication and project management. As new technologies developed and spread among the general public, Learning Places educators adopted these new technologies. Each technology had a different impact on project communication.

Early changes to the budget were never clearly addressed, leading to challenges over the 4-year project.

Budget Management

After submitting the proposal to NSF, the PIs were asked to cut approximately twenty percent from the budget. While the budget was changed, the project proposal was not, which meant changes could not always be anticipated. Discussions of budget-related issues continued to challenge project management and planning throughout the four years. For example, how many face-to-face meetings like the Youth Summit and Collaborative Design Team meeting would be possible? Budget questions also played a role in decisions about whether and when to replace project staff as they left and how to maintain communication across the sites. Since

project leaders did not change the project goals or plans for activities when the budget was changed, and did not clarify the changes to the budget with the core leadership team, the group struggled through many issues that could have been avoided with advanced planning.

Project Staffing

To say that this project is complex brushes over the multiple levels of engagement and involvement by a wide variety of stakeholders, a complexity which will ultimately yield a wealth of information for the field. As the proposal was written and as the project began, however, staff didn't fully appreciate this complexity. It wasn't until the project was well underway that this complexity surfaced and was amplified by staff changes (Table 3).

Table 3. Project Staff Changes

Date	Change in staff
Summer 2005	Co-PI leaves SMM; SMM project manager takes on role of Co-PI; SMM hires interim director for YSC
Summer 2005	SMM project manager takes maternity leave; Interim YSC Director fills her role as Co-PI
December 2005	SMM project manager and Co-PI returns from maternity leave
Summer 2006	Co-PI leaves SLSC; her role is not replaced
Summer 2006	SLSC intern with Learning Places graduates and leaves; her role is not replaced during that year
January 2007	City Technology Co-PI leaves project; the role of Co-PI is not replaced
February 2007	SMM project manager and Co-PI leaves SMM; Interim YSC Director assumes role of Co-PI and new project manager is hired
Summer 2007	SLSC project manager leaves Learning Places; new project manager is hired in St. Louis
Summer 2007	Local science experts are hired in St. Louis and St. Paul
Winter 2008	Interim YSC Director leaves SMM and is replaced by a new director; another staff takes role of LP Co-PI

Though the administrative assistant to the PI was not considered LP project staff, her role in facilitating communication, event planning and travel was critical. With her prolonged illness, increasing absences and later death, her duties were distributed amongst other staff, making some communication difficult, particularly for those outside of the SLSC who had used her as a central contact person and were no longer sure to whom to

address each question or request. Her role was not replaced, resulting in further challenges with communication.

Email and Conference Calls
As the project began, email was the main form of communication, supplemented by conference calls among key project staff initiated from a single phone at the SLSC using a conference call feature. Lost phone numbers, difficulty reaching people, late starts, getting disconnected, and not all call participants able hear each other created challenges. Participants could not join the call late without disrupting the call and many times all participants were disconnected.

Email became a challenge at times with emails "going down," getting lost or "being ignored." Out of frustration, one person suggested information be faxed or sent by carrier pigeon. Most complaints came from people waiting for a response and not getting one. Key staff admitted to reading emails and not taking time to respond to every one. Additional (and perhaps related) complaints arose from the large volume of emails during the second year. This complaint largely disappeared when conference calls began to follow a regular schedule and agendas were set at the end of the previous call.

Eventually, project staff made the switch to a conference calling service in which participants could call into one number from anywhere at anytime with a participant passcode. Allowing multiple participants to use the host passcode enabled participants to start the calls whether or not the PI was available for the call. Thus, as the new conference calling technologies were adopted, communication among project leadership improved.

Websites
In January 2006, museum educators at SMM developed and launched a Learning Places website with features that allowed for document storage, discussion forums, and blogs for sharing information from the two primary sites. Key project personnel were slow to use the website until online training at the March 2006 Collaborative Design Team (CDT) meeting in St. Louis. While the forum feature never took off, the blog feature was used to post updates from the sites including blogs by St. Paul teens, providing an even better picture of the activities in that city.

The St. Louis project staff chose to use a website developed for the Youth Exploring Science (YES) program instead, and later transitioned to a new YES website with more features. By June

A web-based project management program and a conference calling service eventually supported effective project leader communication.

2007, St. Louis teens were blogging regularly on the Learning Places section of the YES website and by October 2007 the new project staff were regularly commenting on teens' blogs. Soon St. Louis teens began to comment back, thus deepening the communication.

At a January 2007 leadership summit in St. Paul, a new website using the Basecamp system was launched for collaborative project management, and was used by Learning Places project staff to varying degrees throughout the project. In the fourth year of the project, the five Phase 2 Museums used the site to post updates and send messages to the group.

Each of the various websites used by project staff and teens differed as outlined in Appendix D. Teens and project staff in St. Paul and St. Louis tended to participate only on websites based in their own institutions. The exception was the collaborative project management website.

Assigning one person to manage communications among project leaders greatly improved communication.

Communication among project staff greatly improved in the third year of Learning Places with the addition of the Basecamp website and with a consultant, former SMM project manager and Co-PI, taking over the conference call scheduling, facilitation and note taking.

Videos and Video Conferencing

Though project staff discussed having teens use video conferencing technology to discuss and share their work, this never came to fruition. Some staff pointed to the different schedules of the two sets of teens as a reason for not moving forward with the idea while other staff members found schedule overlaps. Instead, videotapes and photographs shared the teens' work among project personnel online; however, teens did not access information from the other city and thus were not sharing information first-hand.

Emerging Technologies

Two new web-based programs, Google SketchUp and Doodle, were used in 2008 and 2009. Google's SketchUp (sketchup.google.com) was designed to create 3D models and drawings and was used by some teens to draw scale designs for the physical spaces at the community centers. Doodle, available at online at doodle.ch, provides scheduling technology by polling participants on dates and times they are available for events. This was used by the core team for scheduling conference calls when the time traditionally used for calls became unavailable.

Technology for Collaboration

While the conference calling system, emails, and the Basecamp website were effective tools in bringing the key adult staff and consultants together, the separate websites for the teens and lack of other opportunities for teens to share ideas directly with each other kept the projects in the two cities separate. Comfort levels were an issue with technology just as with STEM teaching and learning. When museum educators were comfortable with the technology, they were more likely to carve out time for teens to blog and time for themselves to respond to teen posts. They were more likely to access the websites and use them effectively for communication and collaborative project management. Time is, of course, another factor, though how museum educators used their time was related to comfort, priorities and goals.

Territorial issues were also at work. Project staffs tended to use and develop sites for their own purposes rather than use sites collaboratively across the two cities. St. Louis adult and teen staff used their own site instead of the SMM-based Learning Places site as the project began. St. Paul staff developed SciSpace at SMM for their teens instead of finding a way to use the YES-based Learning Places' website. Comfort levels were a related factor creating the appearance of territory while masking the discomfort with learning a system created and supported by staff in another city. Local staff support made a difference in technology use and created more of a sense of comfort to those staffs without a strong technology background.

Theory Versus Practice

This project operated on two levels: 1) the national project designed to provide information to other sites and serve as a model, and 2) the local projects in St. Louis and St. Paul that served teens and through their work served children in local after-school programs. Project participants described these two levels as national and local, though the terms theoretical and practical also emerged as descriptors.

Project staff working directly with teens and community partners saw their work as practical. They needed to be prepared for day-to-day programming with the teens, and in many cases needed to be prepared to ensure that teens were prepared for day-to-day programming with children at community sites. These project staff were concerned with supplies, conflicts among teens, communication with parents, transporting teens to sites, and other practical issues.

The national and local focus of the project was a strength and a challenge to project staff.

Project staff working on the national aspects of the project tended to be more theoretically oriented, focused on the big picture and the dissemination of *learning places* and lessons learned. They had the responsibility of compiling the lessons learned from the local sites to scale up to the additional five Phase 2 Museum sites in year 4, creating the deliverables, and reporting to NSF.

The two levels of focus in the project, national and local, added strength to the project. However, they challenged museum educators to think theoretically and practically. Some educators found it difficult to think theoretically when faced with teens' needs or the need to get supplies ready. Some project leaders found it difficult to think practically when faced with national needs and when not facing the same day-to-day challenges of those working directly with the teens.

When PIs and project staff were able to balance theoretical and practical needs and ideas, when they were able to see the strength in each other's perspectives and orientations, the project benefited. However, when this balance did not occur, frustrations grew, leading one Co-PI and one program manager to leave the project. When the balance was missing, challenges in communication and in defining and understanding roles occurred.

Big Ideas and Rich Experiences in Science

Ideas about STEM education changed throughout the project. Three phases of STEM education evolved: Science Content, STEM Debates, and STEM Investigation. (See Appendix E for timeline.)

Science Content

The first phase of STEM education focused on specific content – or lack of content.

The first phase, STEM Content, began as the proposal was written and lasted through the winter of 2006-2007. In this phase, different project staff and PIs had different views on science education, but the differences were not clearly identified or apparent. The focus was on science content. Meeting discussions often included questions about content, most often with PIs and consultants asking project staff what content and STEM concepts were being covered. Consultants assumed museum educators had learning objectives focused on specific science concepts and principles, however, not all educators did.

Differences began to emerge and were expressed as frustrations. Project staff in St. Louis without formal science backgrounds grew frustrated at these very formal science education like questions

and what they perceived as implications that they weren't doing their jobs right. Project staff in St. Paul with formal science education backgrounds understood the nature of the questions but grew frustrated with the nature of the conversations. The Co-PI from City Technology grew frustrated with what he perceived as a lack of communication and was concerned about the training of the afterschool staff in the community centers.

Thus, on the one hand there were those who thought in terms of STEM concepts and curriculum development from a formal science education background. On the other hand there seemed to be those without a formal science education or curriculum development background who perceived the others as questioning their ability to lead the youth program. Perhaps in the middle were those with informal science education backgrounds who saw both perspectives but grew weary of the seeming lack of the other two groups to communicate clearly.

It would be easy to offer the distinction between formal and informal science education as the impetus for the differences in opinion. While this is probably an important factor, there were other factors as well, including personalities, differences in backgrounds in youth development, and communication styles to name a few.

In the second phase, issues of STEM education were discussed and debated.

STEM Debates

The second phase started toward the end of the 2006 and lasted until the core team met in St. Paul in August 2007. In this phase the different opinions on STEM education were articulated, discussed and debated. When it became clear that differences would not be easily resolved, the Co-PI from City Technology resigned.

The evaluation report submitted in May 2006 framed the initial debate in this way:

> Is the goal for the learning places in the community centers to have children (and community center staff) learn and understand new STEM content, develop science process skills, develop a comfort level with STEM, open file folders in the brain for future STEM content, all of the above or some of the above? The goals for the learning places need to be decided before we can expect the teens to develop the learning places needed to achieve the project's impacts. The goals for the learning places need to be clearly articulated so they can be understood by teens, community partners and museum staff, and can be measured through evaluations by teens and the project evaluator.

A meeting in St. Paul in January 2007 of project leadership included a clear articulation of the views of those remaining in the project. At this meeting, a subgroup formed to examine STEM education in the project. Following the group's recommendations, a part-time person with a strong science education background was hired at each site to work directly with the teens, and national informal science education consultants were brought in to work with project staff.

The subgroup also recommended that the Learning Places project identify 2-3 "big ideas" in science to which all children in all sites would have exposure, "big ideas" that would be the same across all sites though not necessarily at the same time. The subgroup produced a document defining "big ideas."

> Big Ideas are a way of organizing the vast, dynamic body of scientific knowledge and questions that exist today. Although there are a number of Big Ideas, each with multiple concepts to be explored, at any given time most science educators tend to focus only one or a few concepts from a particular Big Idea. Once we have one or more Big Ideas for LP, we will have a widely acceptable tool for project-wide planning and public communication.

Examples of "big ideas" based on work the teens had started earlier included the concepts of systems and energy flow. Two documents were developed in June 2007: Big Ideas and Rich Experiences in Science; and, LP Big Ideas Guidelines. The first document was described as a tool for talking about Big Ideas, and the second was identified as the final document on phase one of the Big Ideas planning. Neither document was used and the group eventually disbanded.

Throughout this STEM Debate phase, PIs, staff and consultants continued to discuss STEM education. As relationships and trust grew, ideas and opinions were expressed more openly and more clearly. The project leadership prepared for the next phase.

In the third and final phase, leaders agreed to focus on investigation and the process of scientific inquiry.

STEM Investigation

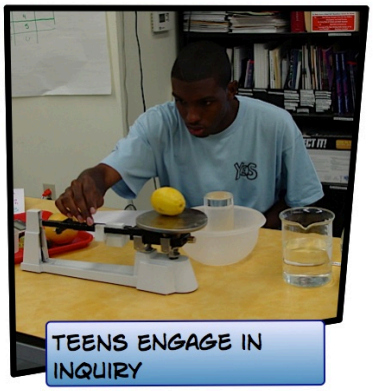
In August 2007, PIs and project staff met again in St. Paul. The participants agreed that the focus of the *learning places* was investigation, and the *learning places* became known as investigation stations. It was suggested that teens learn science content in house (at each museum) and consultants advise teens on pedagogy for the investigation stations. It was also agreed that each site would base its content on the needs of the site and the

resources available, rather than having similar content across sites. Similarity could be found in the process. The big idea would be the process of investigation and inquiry rather than content related.

The following are excerpts from meetings notes of the August 2007 meeting taken by one participant:

> Informal ed is not about taking a curriculum with an objective… A goal from a station might be children will learn 4 things about the mechanics of cars moving…then it is open ended.
>
> The goal of the project is not to give the staff at the community sites content understanding but to make sure they are invested in the investigation process.
>
> What are the things to work on with the community staff? Not so much how to do science activities – but explain to staff how activities assess needs, help them to determine what they do with that information, and teach them how they can allow children to explore. If the science investigation process becomes part of the culture at a community center then the LP goes beyond the physical space. It is like reteaching the learning process - then it feels better in working with the children and helps people to explore and find resources. Help the community staff learn to keep a process from stopping.
>
> The LP project wants to teach community staff how kids engage and learn instead of learning specific things. So secretly the LP project wants to impart teaching skills in general but science is the vehicle that the group uses because the community sees that as the area of expertise.

In summary, the group decided not to focus on specific STEM content but rather the process of investigation and inquiry as a pedagogy for children in afterschool programs. As discussed in a February 2008 conference call among the core leadership team, one person said, "We are interested not in what the youth do or don't know – but how they approach problems." The emphasis was on how teens learn science and how they think about that learning at a metacognitive level.


TEENS ENGAGE IN INQUIRY


CHILDREN EXPLORE SCIENCE

In this same February conference call, it was acknowledged that "afterschool provides a place to explore without being tested." Project staff speculated that attitudes toward academic learning might be positively affected by this experience but academic content learning might not be present. This hinted at a long-standing issue among informal science

educators that goes well beyond this project: schools teach STEM content and we are not schools, so what is our role in science education? In this phase of the project, the response was that our role is to help teens and younger children learn how to learn, learn how to identify and investigate problems, and develop a positive feel for learning science.

Focus shifted to process rather than content.

As this phase continued, the project staff, including the newly hired science experts, talked about the investigations in terms of topics or activities. This placed STEM concepts in the background. The focus on process drove the discussions and the development of the activities at the community partner sites.

Rich Foundational Experiences

As adult and teen educators worked with children in the *learning places* throughout the third phase of STEM education, they began to recognize the importance of providing children in LP's with opportunities for rich experiences with materials to support exploration of science concepts and Big Ideas. Thus, it was believed that children who may not have previously experienced the joy of discovering simple basic science through "play", should have multiple opportunities to tinker with common materials, formulate questions, manipulate variables, and observe properties.

Experiences through play and tinkering became a focus to lay a foundation for later school – based learning.

As the *learning places* developed they included opportunities for rich foundational experiences. Water play in St. Louis allowed children without easy access to sinks and bathtubs an opportunity to experience water flow and the changing shape of water. Experiences with sand were provided to children in the Midwest without access to sandy beaches. St. Paul children played with light, shadows, wind, and balls on tracks with materials they could not access at home. While all these experiences might be common for middle class children from the suburbs, they remain a critical foundation for learning that some children may miss. Learning Places made a conscious effort to provide these experiences.

The impact of this requires further study. Does providing such "rich foundational experiences" improve children's readiness to learn science and mathematics in school? Does this reduce the achievement gap? Learning Places partners began to seek funding to explore rich experiences further.

LESSONS LEARNED FROM PHASE 2 MUSEUMS

Lessons learned from partnering Phase 2 Museums came from interviews, progress reports and the posters they created for the LP Collaborative Design Team meeting held in St. Louis in June 2009. Each museum began the project with a different degree of experience with teens and youth programming. Each began from a different type of relationship with their community partner. These differences were reflected in the lessons they learned.

Youth Involvement

All five Phase 2 Museums involved teenagers in creating *learning places*. Some teens led activities with younger children, some created physical spaces, and those with the Challenger Center served as coaches to younger students on a robotics team. Each museum found out just how busy teens can be with school, sports, work and family commitments. Flexibility was needed.

Partner museums recognized the fine line between high and realistic expectations for teens.

Partner museums found the teens to be good role models for younger children. Most found most of their teens to be interested, capable, and responsible, yet none were without occasional problems. As the staff at the Pacific Science Center noted on their poster for the final Collaborative Design Team meeting: "Developing reasonable expectations for teen participants is no easy task. We need to walk a precarious line between high expectations and realistic expectations. Teens are not adults and are not children. We need to provide challenging growth opportunities without setting them up for failure."

Those museums with longer histories of programming for teenagers appeared to have had more success at walking this line, though we do not have enough data to make a clear claim regarding that. The LP staff at Explora worked with the teens for a year and a half with positive results. Those with short-term teen involvement or infrequent interactions noted more challenges with the youth.

Several partner museums reported challenges with having the teens take the lead on facilitating activities. Teens were more comfortable leading short, discrete activities with clear directions than leading an entire inquiry-based session with children. Even those teens with experience leading activities with the public in galleries found it more challenging to lead children in community settings.

The staff at Headwaters Science Center noted a loss of Teen Leaders at one club because they were overwhelmed with too many enthusiastic youngsters. The staff explained: “Working with Native American communities is, in some ways, less complicated than working with ordinary communities. [Both clubs on reservations] limited the number of children who participated in the science activities, thus providing a far superior outcome for Teen Leaders. In situations where other children wish to participate, the activities are repeated; allowing the Teens to hone their skills.”

Community Needs

Meeting the needs of community partners proved challenging, yet led to success.

The more successful the Phase 2 Museum was in meeting the needs of their community partner, the more successful they reported their project to be overall. Meeting the needs of the partners proved challenging, however. Two examples offer insights into this challenge.

In Seattle, one community liaison recognized the needs of the families in her area and worked with the staff at the Pacific Science Center to meet those needs. Rather than using traditional methods of recruiting children to attend their Science Days, the liaison gave information to families as she collected rent checks. Knowing that the families didn’t feel safe in sending their children outside of their apartment building, the activities were held in the building’s recreation room.

In Albuquerque, museum staff recognized that transforming physical spaces in the communities’ centers would require far more resources than available and was not what the community needed. Instead, they created portable exhibit like spaces that could be set up in multipurpose rooms for science activities and then removed when the activities ended.

Scheduling

Perhaps the most challenging for everyone was the scheduling. Working within the schedules of the teens, museum staffs and community partners often meant meeting less frequently than originally anticipated or desired.

LEARNING PLACES

Four different approaches to the designs of the physical *learning places* emerged, each with lessons to share.

- The prototype at Torre in St. Paul that focused on the space for STEM activities and the storage of materials to support those activities
- Early prototypes in St. Louis focused on pets and water tables
- Walls, ceilings and floors in St. Louis community centers covered with STEM-rich art and materials to engage the creativity of the children
- The final St. Paul portable interactive exhibits with materials to allow for investigation and exploration

Each of these supported the STEM activities in different ways, yielding different insights.

Use Of Space And Activities In Learning Places

In each of the four design approaches the physical space and STEM activities came together in different ways. At Torre, the activities focused on materials, such as in the jitterbug activity. Tables, chairs and counters allowed for room to create the jitterbugs. Space for drawers of batteries, motors and other supplies kept materials readily available for the children. The design of the physical space focused on the support of the activities through materials management rather than a curricular connection between the space and activities.

Early work in St. Louis included setting up tanks and cages for classroom pets in the community centers along with activities around habitat and living things in the first summer. Children and community center staffs were expected to care for the animals when teens were not there, though investigations with the pets were never really supported long-term. In the second summer, stream tables, later changed to water tables, were then set up in the community centers. Teens led activities with the tables, and anecdotal evidence suggests some community staff continued to use the tables when teens were not present. The addition of a cage or table to the existing community center's space helped LP teens and staff understand the challenge of designing *learning places* for the diverse needs of the community partners, even though these were not used in subsequent designs.

Like at Torre, the final St. Louis *learning places* were designed in collaboration with the community partners, taking into account their needs and goals for the spaces. St. Louis *learning places* incorporated some space to store supplies at a couple of sites, though relied on each site's own tables, chairs and floors for activities. With more time and resources than the St. Paul teens' working on Torre's design, St. Louis teen and adult staffs covered walls with STEM related artwork and materials. Each St. Louis site had different STEM content areas as a focus and materials on the walls supported the focus. Larger items like water tables and animal cages were not included.

PLANT INVESTIGATIONS AT GATEWAY

Each of the five community centers in St. Louis differed in their *learning places* design and in the utilization of the space. At Gateway Homeless Shelter, for example, the materials on the walls and floors were used in the activities on plant growth. At Girls, Inc., however, the materials on the walls were decorative and created a fun learning atmosphere, but they were never incorporated into the activities or used in any learning process. The Learning Places areas focused on plant growth brought the physical space design into the activities, though most of the rest of the *learning places* kept the activities separate from the space and could have occurred in any classroom setting.

In St. Paul for the final three sites, teens and CommonBond staffs agreed to create portable *learning places* that could rotate through the Advantage Centers rather than changing the physical space of the centers. In this way, the *learning places* utilized the tables, chairs, floors and storage areas of the sites. The materials in this design were directly connected to the activities, unlike those in some St. Louis *learning places*. For example, the Light Play *learning place* included a shadow box and other interactive exhibit like features plus materials for the children to use as they explored the lights and shadows. While these activities could occur in any classroom or other setting, they included more extensive materials and investigations than those in St. Louis.

LIGHT PLAY AT CATHEDRAL HILL

Each design offered an opportunity for children to engage in learning activities. However, only the portable designs in St. Paul and the plant areas in St. Louis brought the design of the space into the investigative process in ways discussed by the early descriptions of *learning places*. Needs of the community center staffs and the design and STEM education understanding of the museum staff limited the design of the *learning places* in ways not anticipated in the planning of the project. While professional educators and exhibit designers could have created different *learning places*, the critical element of teen involvement would have been missing and would created a very different yet also limited result.

Learning Places Activities and Staff Involvement

At the first Youth Summit in St. Paul, teens and adults decided *learning places* should be "self-serve" such that children should be able to walk in and engage in investigations without the need for staff to direct them. The *learning place* at Torre was created with this in mind. Teens knew children would have difficulty reading directions, so directions were in the form of Commic Life step-by-step illustrated directions and in a video. The teens soon found that the children wanted their interaction and direction. CommonBond staff and volunteers expected this teen guidance.

St. Louis teens found the same to be true. Community center staffs expected the teens to lead activities and only used the *learning places* when the teens were present to lead them.

Each city handled this differently. In St. Louis, teens continued to lead the activities and community partners continued to ask for teen or adult SLSC staff to bring activities to the sites. In St. Paul, however, the teen and adult museum staff trained the CommonBond staff in the rotating activities. CommonBond took it further and hired an AmeriCorps volunteer to continue the work of the teens. Thus, they recognized the need for someone to personally guide the children in the investigations. They created a sustainable model without the need for SMM staff involvement other than in a supportive partner role.

DISCUSSION – GROUNDED THEORY

The Findings above describe results of the evaluation in terms of the project goals, as is typical in program evaluations. Since the Learning Places evaluation used naturalistic inquiry aimed at understanding rather than a more traditional approach, such a list of findings merely provides a backdrop for the grounded theory that emerged from the process. In this section, rather than conclusions, the grounded theory that emerged from the study is presented. It should be noted that this theory is derived from the data with input from all the participants rather than just the evaluator.

By its very nature, grounded theory should enable prediction and explanation of behavior, advance the theoretical underpinnings of the field, have practical applications, and guide further research (Glaser & Strauss, 1967). If this report is successful in those areas, the theories put forth here will evolve as others apply and study them.

Five areas of theory emerged through the naturalistic inquiry in this study: STEM learning, agents of change, teens as designers, community partner engagement and national collaboration.

STEM LEARNING

Theory: Success in STEM classes in school requires key foundational experiences. When children and youth miss these experiences, they miss key concepts. After-school programs can provide rich experiences to lay the foundation for further STEM conceptual understanding in and out of school.

The value of the *learning places* for children at the community centers was not in learning specific STEM content. We found that children continued to hold on to misconceptions at times, found their conceptions challenged at others, and only occasionally gained new understanding of STEM concepts. The value was instead in the exposure to the process of investigation and experiences with materials the children would have otherwise missed.

When Learning Places teens led children in water activities, it became clear that the children didn't come to the activities with a clear understanding of the properties of water. Since this understanding is often assumed by the school's curriculum, it was ***hypothesized*** that one factor involved in the achievement gap is the lack of foundational experiences needed prior to exposure to more advanced concepts in school.

When St. Louis teens brought live animals to the community centers, it was clear that many of the children had not had the opportunity to care for a pet. When St. Paul teens took batteries and motors to the Torre Advantage Center, it was clear that many of the children had not had the opportunity to use batteries

or see a motor in action. Since national and local science standards lead to curriculum and assessments that require knowledge of living things and electricity, and since the children didn't seem to have the foundation needed to understand the concepts, we ***hypothesized*** that after-school programs could fill an important need in low-income families by providing rich, foundational experiences.

If we put this theory into practice, we need staff in the community centers to lead children in these experiences, and we need the curriculum and materials necessary for the experiences. Learning Places teen and adult staff at the museums attempted to support the staffs at their community partners in guiding such experiences and provided the materials and curriculum to do so. Additional work is needed to identify barriers to providing such experiences. From the beginning of the work through Learning Places, additional theory emerged.

Theory: Guiding children and youth in investigations to create rich STEM experiences requires after-school program staff who understand inquiry and are comfortable with the STEM content and materials. Guiding those educators to lead such experiences requires additional personnel, in this case at the museum, who have the skills to train educators in leading investigations and who have a high degree of STEM comfort themselves.

Learning Places educators in after-school programs at the community centers and in the museums were experts in youth development and early childhood education. Most were not STEM educators and many were uncomfortable with the science. It was clear we could not expect after-school program staff and museum youth development staff to become STEM educators quickly. However, we ***hypothesized***, and found to some extent, that these educators can become champions for investigations and rich experiences. This requires professional development. Experiences with this professional development in Learning Places are described in the narrative record (www.smm.org/learningplaces).

It was assumed going into the Learning Places project that all museum educators could guide the teens and after-school program educators in leading investigations and inquiry-based activities with a little curriculum support from the content experts at City Technology. This assumption was proven false. The museum educators came to the project with different talents and skills. Some were experts in youth development without STEM content background or comfort. Some were STEM education experts without experience in youth development. Others had experience with youth development and STEM education, and could thus lead activities effectively with the teens.

Beyond leading the inquiry-based activities themselves, museum educators were asked to train the teen and after-school program educators to lead activities. This required museum educators to be expert trainers. A new

hypothesis emerged: for museum educators to train teens and after-school program staffs, they must develop the necessary train-the-trainer type skills.

Learning Places museum educators received professional development (PD) in leading inquiry-based activities, though most PD focused on how to lead activities rather than how to train others to lead activities. Additional PD through the Exploratorium's Institute for Inquiry and PIE (Playful, Invention and Exploration) workshops helped museum educators in this area.

The theory states that, prior to the skills necessary to lead STEM investigations, staffs must have a high degree of comfort and experience with the materials themselves. As the St. Louis teens were attempting to place live animals in the community centers, it became clear that some museum staff, some community center staff and some teens were not comfortable with the animals and had never raised pets themselves. The PI suggested that all YES staff have pets in the Taylor Community Science Center to build their comfort before attempting to lead teens or children in caring for class pets in the future. As teens created stream tables in St. Louis, educators recognized their own lack of understanding and accessed the expertise of other museum staffs, learning along with the teens before taking the tables to the community centers. When teens in St. Paul decided to create wind tunnels for their *learning places*, they acknowledged their lack of experience and called on other teens and staff from the museum in the design process. Our ***hypothesis*** became: all educators must acknowledge their own lack of comfort or experience, seek support from others, and develop the comfort and experience necessary before leading children through those experiences.

AGENTS OF CHANGE

Theory: Educators must see themselves as agents of change before they can expect that of the youth they are guiding.

This theory emerged as one program manager exhibited the behavior of a pawn rather than an origin. She spoke of the project as if it belonged to others rather than seeing herself as an agent of change in the lives of the teens. At times, she would delight in the achievements of the teens and remark on her pride in them, yet she never consistently saw her own value and worth in the project. In hind site, it would have been helpful to have the staff take the Origin/Pawn assessment too.

A ***hypothesis*** could be stated as: to support teens in seeing themselves as agents of change, staff must be hired who see themselves in that light, or staff must receive the training and support to get there. Since the Learning Places program manager did not receive any formal training or direct support in originship while in the project, this hypothesis remains untested and only speculative. It might be the case that educators would have to be hired with that mind set, rather than trained or supported in developing it.

Theory: Teens find teaching younger children to be meaningful. Providing teens with meaningful roles as educators gives teens a sense of agency.

Learning Places teens found their work with younger children meaningful. As described in the Findings section, St. Louis teens didn't consistently lead activities with children before trying them out themselves in the early years of the project, while St. Paul teens always tried out activities first, sometimes on peers outside of the Learning Places project. Our ***hypothesis*** emerged as: running through activities with peers before leading the activities with children leads to greater success and thus greater sense of agency on the part of the teens.

Related to that, we ***hypothesized***: leading activities in the same fashion and doing what has always been done does not lead to improved sense of agency. While it is never a good idea to state a hypothesis as a negative, the opposite is not necessarily true, i.e. breaking out of the box and doing things differently leads to improved sense of agency. There are too many other factors involved to make that claim.

When St. Louis LP teens, many of whom had been in the YES program before, led activities the first summer as they had done in other projects, the work did not take on new meaning. When many of these same teens began to create actual *learning places* and engage children in investigations with water and sand, the teens appeared to find meaning and see more value in their work. In St. Paul, the youth knew the community sites well and knew how very different their work was for the children. They readily found meaning and saw themselves as agents of change.

YOUTH AS DESIGNERS

Theory: Designing *learning places* requires skill in design, STEM content and pedagogy. Involving teens in the process enriches the outcome. For teens to take the lead in this design process requires extensive training and resources.

The design of the final *learning places* did not match that expected as the project began. It became clear that community centers had different needs, youth had different skills, and museum staffs had different understandings of the project than originally anticipated. Community partners in St. Paul eventually asked for portable *learning places* rather than changing their physical spaces. Community partners in St. Louis asked teens and museum staff to continue to lead activities rather than developing the skills to lead them internally.

The museum educators in St. Louis and St. Paul saw the project differently. The first St. Louis program manager focused on activities she and teens had always done – short activities that could stand alone. The first St. Paul program manager focused on design of the space in relation to STEM activities. Most

teens came to the project without experience in leading STEM activities and without strong STEM understanding. Thus, in St. Paul educators balanced the design process with developing STEM understanding and experience of inquiry-based activities. The St. Louis museum educators had teens developing activities to lead and measuring spaces.

In both cases, it became clear that to design *learning places* would require the adult and teen educators to understand design, pedagogy and the content. Each museum handled this differently and achieved different results. What became clear was the value in involving the teens. A ***hypothesis*** emerged: while *learning places* could have been designed by professional designers and educators, teen involvement in the process created a richer experience for the children.

The teens brought their creativity to the *learning places* in the materials they selected that engaged the children. They brought their youthful outlook as they selected activities that they believed would best bring about children's learning. While we believe this hypothesis to be true, additional research could further identify effective roles for youth, educators and designers.

COMMUNITY PARTNER ENGAGEMENT

Theory: When community partners are clear on project goals, engaged in the development of the project, and invested in the outcome, they are eager to sustain successful projects.

In St. Paul, the community partner, CommonBond Communities, was involved from the beginning in the planning of the project and writing of the proposal. In St. Louis, the community partners had developed a long-standing relationship with the St. Louis Science Center, but were not involved in the earliest stages of the planning. All community partners were invited to the first Collaborative Design Team meeting in St. Louis midway through the project.

As the project came to an end, the St. Paul partners were developing a sustainable model using AmeriCorps volunteers and staff to develop new *learning places* and keep the current *learning places* functioning. In St. Louis, partners differed in their enthusiasm to sustain the project. Some wanted to return to the pre-Learning Places plan of SLSC teen and adult educators providing programming, while others were seeking resources to bring the *learning places* to a more integrated and professional stature. The emerging ***hypothesis*** is: The more involved the community partners are in the planning and development of the project, the more likely they are to sustain the project after the funding ends.

Community partner staffs had different degrees of interest in the outcomes of the Learning Places project. With teens from the CommonBond sites involved in the design of the *learning places* in St. Paul, the front-line and management

staffs were eager to see the project succeed. The Liaison position between SMM and CommonBond supported this effort too. In St. Louis, directors at the five sites understood the project and applauded its goals, but the front-line staffs varied widely in their understanding of the project and their buy-in. The front-line CommonBond staff in St. Paul supported the teen and adult educators at every step, while the front-line community center staff in St. Louis sometimes saw the teens as just one more group coming to offer a program to their children whether or not it fit into their plans. Another ***hypothesis*** is: the more community partners' front-line staff can be involved the planning to share the goals, the more they are likely to support the project and help to sustain it.

NATIONAL COLLABORATION

Theory: National collaborations with multiple partners in different settings and geographical locations require clear communication, clearly defined roles, strong leadership and similar philosophies. As the project evolves, so must the communication, roles, leadership and even the philosophy.

Literature on collaboration is clear on the need for shared vision, clear communication, defined roles, leadership and shared philosophy. In Learning Places we found a constant evolution of the project as staff and teens changed and as new ideas on the design of *learning places* were tried. A ***hypothesis*** emerged: successful complex projects evolve as relationships stabilize, allowing the projects progress.

We saw the Learning Places project begin its evolution as the first Co-PI left her museum. The steady stream of changes in project leadership led to ongoing evolution of the project. As it changed, the project required new definitions of roles and new forms of communication. When this was slow in coming, the project suffered. When staff embraced the changes and made quick adjustments in roles, the project moved forward effectively. For example, when the Co-PI and program manager roles in St. Paul were to change as one person returned from maternity leave or was scheduled to leave the museum, SMM responded by building in a clear transition process with clearly defined roles to make for a smooth transition. When the Co-PI from City Technology left the project, both museums began the hiring process to bring in STEM expertise at the local level. When the Co-PI from St. Louis left the project, however, her role was not defined or reassigned until much later in the project when the gap had become apparent and led to challenges.

Technologies, such as the Basecamp system, were used to supplement regular phone conversations in Learning Places. A new ***hypothesis*** emerged from this: when technologies are used to support clear and regular communication, the collaboration remains focused on project goals and audience.

Through Basecamp, email messages and meeting notes were archived so those who missed them the first time around could read them and were held

accountable for them. The To-Do function enabled project leaders to stay on target with milestones and activities. Other Basecamp features supported project management and communication. Even with this technology, the project leaders needed to stay current with their communication. Even with this technology leaders took breaks from communication and the project suffered. Thus, the technology is only a tool to support communication and management and not a replacement for good leadership.

In a separate document (found at www.SMM.org/learningplaces), research questions that emerged from the project are presented with methods for collecting evidence and considerations for researchers. These are more general than the grounded theory above, though both are shared to encourage further study.

REFLECTIONS ON THE EVALUATION

The previous sections focused on the results of the Learning Places evaluation. In this Reflection section, we step back from the evaluation and reflect on the evaluation itself.

Several lessons can be learned from the Learning Places evaluation process. The Origin/Pawn Assessment proved more labor intensive than originally planned, though provided useful insights. Obtaining enough completed assessments to compare pre and post was most challenging. In hind site, it would have been wise to schedule more times for the assessment. As was already suggested, staff should have taken the assessment too. Perhaps the combination of these changes would yield more completed assessments.

Analysis of the blogs and journals was too brief, yet yielded useful results. The lesson here is in the evolution of the project as it moved from hand-written journals to public blogs. As a project changes, the evaluation must change too. With a limited budget, those changes are not always what we would prefer.

In the interview process to assess teens' understanding of STEM concepts, teens were asked to predict and describe what happened with materials used in novel ways. This process proved very useful, particularly in the third year when actual materials were manipulated. It would have been even more insightful, however, to allow the teens the time to actually conduct their own investigations while observing their process and having them reflect on their findings.

Having children reflect on activities in the *learning places* through focus groups gave some information on the children's understanding and problem solving. It would have been more interesting to use the same process as used with the teens – have the children use the same materials in new ways to see how they applied what they had previously learned.

CONCLUSIONS

In reflecting on the Learning Places project as a whole, the complexity provided insights we never could have imagined in the beginning. The evolution of the project and emergent grounded theory benefited greatly from the involvement and commitment of key project staffs and consultants.

The unique features of the project and the unique combination of partners and participants yielded results that could never be replicated. Regardless, the insights and grounded theory from Learning Places are already serving to produce new projects. From these and others, we should see the real impact of the Learning Places project as its hypotheses are tested and its theories are expanded and improved upon.

Much was learned through the Learning Places project. The greatest challenge was capturing and sharing those lessons. This summative report attempts to report some of those lessons. The narrative report, resource guides and other information on the learning Places website (www.smm.org/learningplaces) are additional attempts.

Perhaps it is best to sum up Learning Places by saying many of the original project goals were met, but much more was learned (intentional and unintentional) by all participants than we could have imagined five years ago.

One advisor put it this way, a fitting final statement:

> The bottom line...Learning Places provided a professional forum where everyone learned, children, teens, teachers, even academics and experts. It was the rich "Stone Soup" of people getting together to do things worth doing, and learning by doing. Hands-on and heads-on. My opinion is that we each learned something for ourselves and that we gave what we had to give, and we grew.

IN MEMORIUM

The Learning Places leaders, SMM staff, CommonBond staff and St. Paul teens will always remember Stacy Morgan for her insight and compassion.

The Learning Places leaders, St. Louis YES staff and St. Louis teens will always remember Gloria White for terrific organizational skills and support.

REFERENCES

Brown, A., & Campione, J. (1996) Psychological theory and the design of innovative learning environments: On procedures, principles, and systems. In L. Schauble & R. Glaser (Eds.) *Innovations in learning: New environments for education* (pp. 289-325). Mahwah NJ: Lawrence Erlbaum Associates.

deCharms, R. (1989) Introduction to personal causation and the origin scoring manual. Unpublished manual. St. Louis, MO: Washington University.

Glasser, B. G., & Strauss, A. L. (1967) *The discoveries of grounded theory: Strategies for qualitative research.* Hawthorne, NY: Aldine de Gruyter.

Guba, E. G. & Lincoln, Y. S. (1994) Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.) *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications. pp. 105-117.

Hall, G., Israel, L., & Shortt, J. (2004) *It's about time! A look at out-of-school time for urban teens*. Wellesley, MA: National Institute on Out-of-School Time.

Koke, J. & Dierking, L. (2007) *Museums and libraries engaging America's youth: Final report of a study of IMLS youth programs, 1998-2003*. Washington, DC: Institute of Museum and Library Services

Mattessich, P. W., Murray-Close, M., & Monsey, B. R. (2001) *Collaboration: What Makes It Work, 2nd Edition*. St. Paul, MN: Amherst H. Wilder Foundation.

APPENDIX A: Learning Places Partners

Museums:

- Saint Louis Science Center, St. Louis, MO
- Science Museum of Minnesota, St. Paul, MN

Community Partners in St. Louis:

- Gateway Homeless Shelter (formerly Christian Services Center)
- Girls, Inc. of St. Louis
- Grace Hill Head Start
- Herbert Hoover Boys and Girls Club – Adams (formerly Adams Community Center)
- Herbert Hoover Boys and Girls Club – Grand

Community Partner in St. Paul – CommonBond Communities – at locations:

- Cathedral Hill Homes
- Skyline Tower
- Torre de San Miguel Homes
- Westminster Place

University Partner:

- City Technology project at the City College of New York

Partner Museums:

- Explora, Albuequerque, NM
- Headwaters Science Center, Bemidiji, MN
- Lower Hudson Valley Challenger Center, Airmont, NY
- Pacific Science Center, Seattle, WA
- Sci-Port, Shreveport, LA

Consultants:

- DeAnna Beane
- Veena Kaul
- Christine (Kit) Klein, Evaluator
- Theresa Stets

National Advisors:

- Barbara Addelson
- Bronwyn Bevin, Exploratorium
- Joe Burzinski, Fox Architects
- Peter Dow, First Hand Learning
- Rebecca Dyasi, Long Island University
- Ellen Gannett, National Institute on Out of School Time (NIOST)
- Shirley Brice Heath, Brown University
- Gloria Jackson, Ewing Marion Kaufman Foundation
- Ron Jackson, St. Louis For Kids
- Darlene Librero, Exploratorium
- Deb Loy, 21st Century Community Learning Centers
- Gil Noam, Program in Education, Afterschool and Resiliency (PEAR)
- Joe Polman, University of Missouri – St. Louis
- Richard Ponzio, University of California – Davis
- Ellen Rubin
- Erica Saxby, Boys and Girls Clubs of America
- Robert Tai, Cury School of Education, University of Virginia
- Bernie Zubrowski, EDC

APPENDIX B: Project Activities

The following outlines the activities in St. Louis, St. Paul and at the national level for the Learning Places project.

	St. Louis	St. Paul	Nationally
Fall 2005	• Teens hired • Teens learned about design	• Teen recruitment began	• September planning meeting in St. Louis • PI conference calls
Spring 2006	• Teens learned science activities and prepared for summer work • New blog site launched for St. Louis teens	• Teens hired • Teens learned science activities and about informal science education	• PI conference calls expanded to include consultants • Collaborative Design Team meeting and Advisory Board meeting in St. Louis • Website launched
Summer 2006	• New teens hired • Teens provided activities each week to community partner sites • Co-PI and project manager left, not to be replaced	• Teens participated in Design Institute	• Youth Summit – 6 teens from St. Louis and 10 teens from St. Paul participated
Fall 2006	• New teens hired • Teens continued to care for pets at SLSC • Teens developed water activities for centers • CSC children came to TCSRC for activities	• New teens hired • Developed prototype of learning place at Torre	• PI Conference Calls continued • Conference calls with focus on curriculum in St. Louis
Spring 2007	• Teens designed water tables • Teens continued to provide activities to CSC children at CSC • Series of PD workshops for staff began • Local science expert hired in May	• Teens completed installation of Torre LP • New program manager hired in St. Paul to replace outgoing manager • New Interim Co-PI replaces former Co-PI	• Co-PI from City Technology left project • Planning retreat in St. Paul - January • Launch of new management website • St. Paul Co-PI left & began as project consultant

	St. Louis	St. Paul	Nationally
Summer 2007	• Teens spent one week at each community site working with children	• Teens participated in Design Institute • Teens focused on three new CommonBond sites	• Planning retreat in St. Paul -August
Fall 2007	• New program manager in St. Louis replaced outgoing manager • New teens hired • Planning began for learning places at five sites	• Local science expert hired • Teens worked on activities for three learning places • New blog site created for St. Paul teens	• Collaborative Design Team meeting and Advisory Board meeting in St. Louis
Spring 2008	• New speaker series began • Teens and staff began installation of learning places at five sites	• New Co-PI from St. Paul replaced interim Co-PI	• PI Meeting in St. Paul – March
Summer 2008	• Installation of Learning Places completed	• Installation of Learning Places at 3 CommonBond sites	• Partner Museums completed proposals
Fall 2008	• New program managers took over • LP teen group redesigned space at TSCRC	• Installations completed • Teens left SMM as roles completed	• Partner Museums began LP projects • Youth Summit in St. Paul
Spring 2009	• Teen program reconfigured	• Final document preparation • Partners discuss future plans	• LP projects at Partner Museums continued
Summer/Fall 2009	• LP teen program continues as part of YES program • ASTC session participation	• Toolkits completed • Learning Places website put in place on SMM website • ASTC session participation	• Collaborative Design Team meeting in St. Louis • Partner Museums complete LP projects and work to incorporate project into ongoing programs • Resource Guide completed • Narrative Record completed • Research Agenda completed

Throughout the first two years, Veena Kaul, consultant, visited St. Paul and St. Louis to work with the teens on evaluation of the learning places. Gary Beneson of City Technology visited St. Paul and St. Louis through the fall of 2006 to work with teens and staff on science education activities and curriculum development. The St. Paul Advisory Board met quarterly for the first year and the St. Paul inter-agency coordinating group met almost monthly during the first two years.

APPENDIX C: Evaluation Reports and Data

Reports Provided

The following evaluation reports were provided to the principal investigators by Christine Klein throughout the grant.

- Results from the Wilder Collaboration Inventory: Fall 2005 Report
- Learning Places Collaborative Design Team Meeting: Feedback Sheet Summary of Results. Spring 2006
- First Annual Evaluation Report. May 2006
- Interim Formative Evaluation Report. September 2006
- Evaluation Report for Teens. October 2006
- Summary of Findings from Year 1. October 2006
- Observations of Children at Torre: An Interim Evaluation Report. February 2007
- Learning Places Evaluation Report. May 2007
- Learning Places Evaluation Report to the Community. May 2007
- Report on Seatbelt Usage. July 9, 2007
- Learning Places Collaborative Design Team Meeting: Feedback Sheet Summary of Results. Fall 2007
- Collaborative Design Team Meeting: Graffiti Board Results. Fall 2007
- Learning Places Evaluation Brief: STEM Understanding Analysis. February 2008
- Learning Places Third Annual Evaluation Report. May 2008
- Learning Places Evaluation Brief: Content Analysis of Journal and Blog Entries. February 2009
- Learning Places Evaluation Brief: Origin/Pawn Assessment of Personal Causation. May 2009
- Learning Places Evaluation Brief: STEM Understanding Analysis. May 2009

Articles

Klein, C. & T. Stets (2008) Teens for Science! Changing community attitudes and afterschool, The Afterschool Review, No. 2, Spring 2008, 22-25.

Data Collected

The following lists the data collected through the end of May 2009, in date order by method collected.

Blogs from St. Louis and St. Paul Learning Places Public Sites

All postings related to Learning Places through September 2008

Focus Group Interviews

St. Louis Teens: January 6, 2006, March 15, 2007, and June 12-13, 2008
St. Paul Teens, April 19, 2006, April 14, 2007, and June 18, 2008
Torre Children, January 23, 2007
St. Paul Children, June 17, 2008
CommonBond Staff, June 19 2008

Interviews

Gary Beneson, January 2006
Theresa Stets, January 2006
Stacey Ramey, January 2006
Diane Miller, January 2006
Holly Hughes, February 2006
Three St. Louis Teens, March 2006
Janet Madzey-Akale, May 2006
Gywanna Jackson, May 2006
Six St. Paul Teens, May 2006
Theresa Stets, January 2007
Sylvia Elrod, January 2007
Diane Miller, March 2007
Gywanna Jackson, March 2007
Gary Beneson, March 2007
Janet Madzey-Akale, April 2007
Four St. Paul Teens, June 2007
Six St. Louis Teens, June 2007
DeAnna Beane, April 2008
Theresa Stets, April 2008
Keith Braafladt, April 2008
Erica Schram, May 2008
Cara Johnson, May 2008
Meesa Olah, May 2008
Felix Lui, May 2008
Seven St. Louis Teens, June 2008
Diane Miller, June 2008
Four St. Paul Teens, June 2008
John Huibregtse, LHVCC, March 2009
Kitura Main, HSC, March 2009
Kristen Leigh, Explora, June 2009
Teresa Demel, PSC, June 2009
Kristen Takara, Sci-Port, June 2009

Journals

St. Louis Teens, November 11, 2005

St. Louis Teens, January 1, 2006
St. Louis Teens, March 18, 2006
St. Louis Teens, May 6, 2006
St. Paul Teens, various dates, September 2006 to March 2007
St. Paul Team Journal 2006

Meeting Notes

Conference Call, Gywanna, Veena and Kit, October 20. 2005
Conference Call, Janet and Kit, November 7, 2005
PI Conference Calls, 2005 – November 10; December 1 & 15
PI Conference Calls, 2006 – January 26, March 2, April 2 & 20, May 4 & 11
St. Paul Internal Coordination Meeting, February 15, 2006
St. Paul Internal Coordination Meeting, April 19, 2006
St. Paul Advisors Meeting, May 3, 2006
PI Meeting, September 29, 2006
St. Louis Curriculum Planning Conference Calls, 2006 – September 7, 14, 28; October 3
PI Conference Calls, 2006 – October 12 & 26; November 9 & 30; December 14 & 21
Meeting, Stacey Morgan and Kit Klein, January 26, 2007
Big Ideas Conference Calls, January 29, 2007, February 5 & 15, 2007
Core Team Conference Calls, 2007 – April 12, 19, 26; May 3, 10, 17, 24, 31; June 7, 14, 21, 28; July 5, 27, 31; August 9, 16, 30; September 6, 13, 20; October 4, 11, 18, 25, 28; November 1, 8, 29; December 6, 13, 20
Museum Partners Strand Calls, 2007 – October 23, November 1
Planning Retreat, St. Paul, August 23-24, 2007
Core Team Conference Calls, 2008 – January 3, 10, 17, 24, 31; February 7, 14, 21; March 6, 26
Museum Partners Strand Calls, 2008 – January 15, 20; February 19, 28
St. Paul Internal Coordination Meeting, March 14, 2008
PI Meeting, March 10, 2008
Core Team Conference Calls, 2008 – April 25, May 30, June 24, July 28, August 12, September 25, October 10, 16 & 24, November 7, December 19
Core Team Conference Calls, 2009 – January 16, 23 & 30, February 6 & 26, March 5, 12 & 20, April 2, 16, 23 & 30, May 7, 14 & 28, November 1 & 9

Observations of Meetings

Planning Meeting, St. Louis, September 22-23, 2005
CDT Meeting, St. Louis, March 9-11, 2006
St. Louis Staff Development with Peter Dow, May 19, 2006
Parent Meeting for Youth Summit Attendees, St. Louis, June 23, 2006
Youth Summit, St. Paul, June 26-28, 2006
PI Meeting, St. Louis, September 29, 2006
Planning Retreat, St. Paul, January 24-26, 2007

Staff Development, St. Louis, March 26, 2007
CDT Meeting, St. Louis, September 27-29, 2007
St. Louis Staff development with Ellen Rubin, February 29, 2008
PI Meeting, St. Paul, March 10-11, 2008
Speaker series, St. Louis, March 20, 2008
Speaker series, St. Louis, April 18, 2008
Inquiry Workshop, St. Paul, October 7, 2008
Youth Summit, St. Paul, November 13-15, 2008
CDT Meeting, St. Louis, June 11-13, 2009

Observations of Teens

November 5, 2005, St. Louis
November 12, 2005, St. Louis
January 7, 2006, St. Louis
February 11, 2006, St. Louis
February 15, 2006, St. Paul
March 8, 2006, St. Louis
March 18, 2006, St. Louis
April 19, 2006, St. Paul
April 28, 2006, St. Paul
May 6, 2006, St. Louis
May 10, 2006, St. Paul
May 27, 2006, St. Paul
June 6, 2006, St. Louis
June 12, 2006, St. Louis
June 22, 2006, St. Louis
July 5, 2006, St. Paul
July 14, 2006, St. Louis
July 18, 2006, St. Louis
August 8 & 9, 2006, St. Paul
October 14, 2006, St. Louis
November 4, 2006, St. Louis
December 20, 2006, St. Paul
January 10, 2007, St. Paul
January 24, 2007, St. Paul
February 19, 2007, St. Louis
March 17, 2007, St. Louis
April 14, 2007, St. Paul
April 21, 2007, St. Louis
April 26, 2007, St. Paul
June 17, 2007, St. Louis
June 21, 2007, St. Louis
June 25-26, 2007, St. Paul
June 28, 2007, St. Louis
July 2, 11, 17, 20 & 25, 2007, St. Louis
October 17, 2007, St. Paul
November 3, 2007, St. Louis
December 19, 2007, St. Paul
January 22, 2008, St. Paul
February 27, 2008, St. Paul
March 1, 2008, St. Louis
March 29, 2008, St. Louis
April 9, 2008, St. Paul
April 5, 2008, St. Louis
June 12-13, 2008, St. Louis
July 2-3, 2008, St. Louis
July 8, 2008, St. Louis
July 14, 2008, St. Louis
September 16, 2008, St. Paul
October 1, 2008, St. Paul

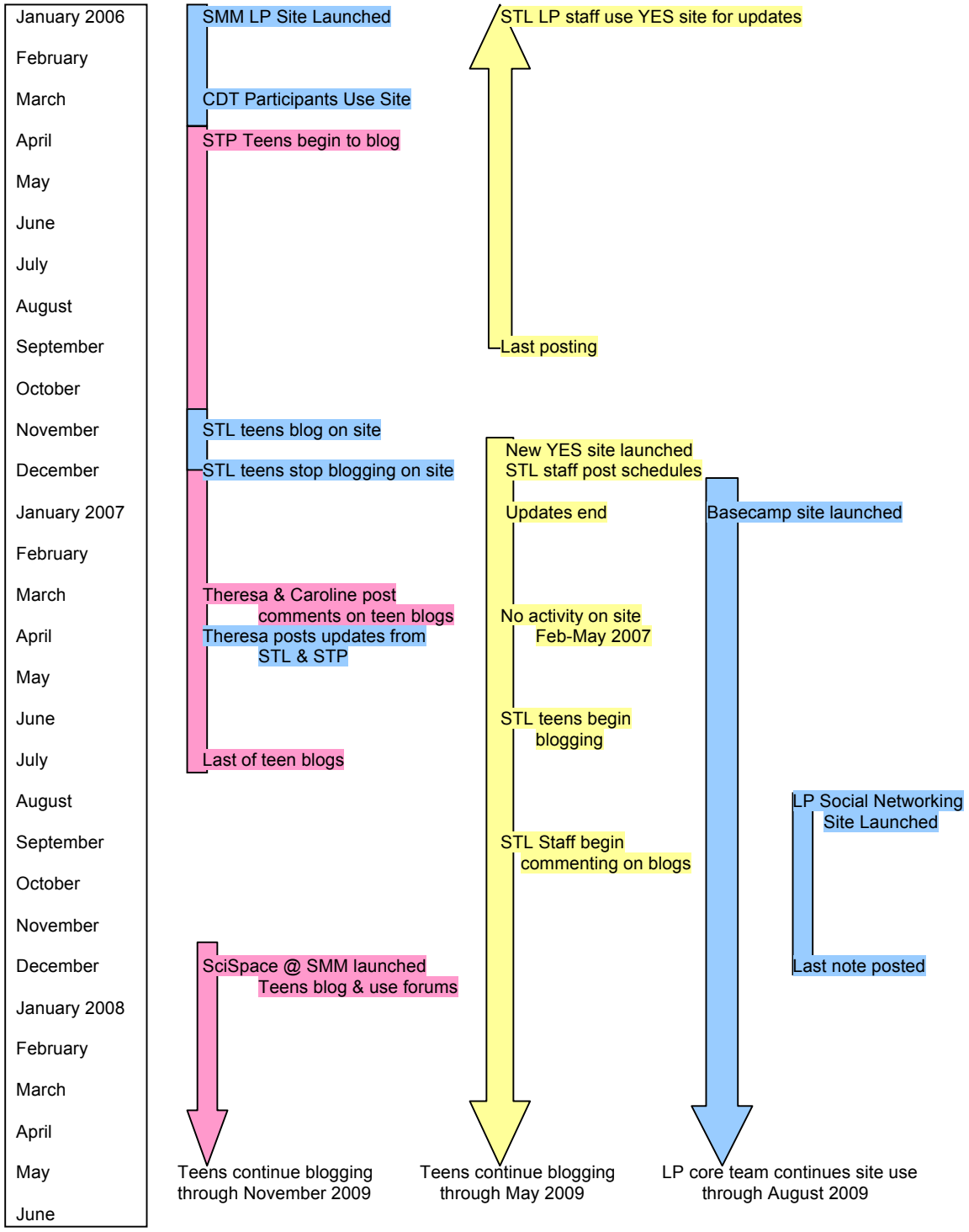
Documents
Partner Museum Proposals and Addenda, Summer & Fall 2008
Partner Museum Reports, 2008 - 2009
Seven Museum Posters, CDT meeting 2009
Evaluations from CDT meetings, 2006, 2007, 2009
Investigation Station Observation Checklists, by CommonBond staff, Fall 2008

APPENDIX D: Websites and their uses from the Year 3 evaluation report

Table 4. Websites Associated with Learning Places

	Learning Places	**Original YES site**	**New YES site**	**SciSpace @ SMM**	**Basecamp**	**LP Ning site**
URL	ltc.smm.org/learningplaces/home	yes.typepad.com	www.youthexploringscience.com	scispaceatsmm.ning.com	youthexploringscience.updatelog.com	learningplace.ning.com
Creator	Keith Braafladt	Cindy Graville	Cindy Graville	Erica Schram	37signals, LLC in Chicago	Cindy Graville
Start Date	January 2006	March 2005	December 2006	December 2007	January 2007	August 2007
End Date	July 2007	July 2006	May 2009	Nov. 2009	Dec. 2009	Dec. 2007
Password Protection	Yes	Yes to post No to read	Yes to post No to read	Yes	Yes	Yes
Primary Members	Open to all CDT participants; only St. Paul teens & staff remain active	YES staff and teens; LP St. Louis staff active Jan., Feb. & June 2006	YES staff & teens; LP St. Louis staff & teens active June 2007 to present	St. Paul staff & teens	LP Core Team With partner museums joining a separate area in 2008	LP Core Team
Blogs	By teens & staff	By staff	By teens & staff	By teens & staff	None	By core team
Comments on Blogs	Comments on teen blogs in March 2007 by staff	None	Comments on teen blogs by staff began Sept. 2007; continues to present	Teens rarely comment on each other's blogs; all members comment on each other's walls	N/A	Members comment on each other's walls and blogs
Forums	Available – not utilized	None	None	Used by teens	Writeboard used in place of forums	Used by core team
Photos	Embedded in notes	Posted within notes & in photo gallery	Posted within notes & in photo gallery (few are labeled)	Labeled and stored in photo gallery	None	Stored in photo gallery (numbered, not labeled)
Videos	None	None	Posted within notes	Labeled and stored in video gallery	None	Video gallery available – not utilized
Document Sharing	Available – not utilized	Not available	Not available	Not available	Available and utilized	Not available
Other features				Individualized walls for social networking	Milestones used; To-Do lists active; Writeboard used for collaborative document development; Chat not used; Time not used	Individualized walls for social networking

Figure 6. Timeline of Website Activities by Learning Places Adult and Teen Staffs



Legend – activities color-coded by host of site (arrow color) and participants (text color)

St. Paul St. Louis National Project

APPENDIX E: Timeline Of STEM Education Activities & Discussions

The following timeline provides a brief overview of the background of science education philosophies and big ideas discussions throughout the project.

Table 5. Timeline of STEM Activities

DATES	ACTIVITIES
January 2005	Proposal submitted
April 2005	Negotiations occur with NSF and the project is funded with a decreased budget. No changes are made to the goals.
January 2007	Co- PI and STEM content/curriculum expert resigns. The core team meets in St. Paul. A subcommittee forms to examine the science education piece once the STEM curriculum expert has left. *Big Ideas* are the focus of the subcommittee.
February 2007	Evaluation report on Torre children's understanding of STEM is submitted to PIs and project staff.
Early Spring 2007	The subcommittee meets via conference calls and emails to discuss STEM education and *Big Ideas*. Documents are drafted; then the group stalls.
Late Spring 2007	The subcommittee suggests Rebecca Dyasi, consultant, identify 2-3 *Big Ideas* to use. Subcommittee drafts *Big Ideas* guidelines to give Rebecca Dyasi, who visits St. Paul and St. Louis.
May 2007	Science content expert is hired part-time in St. Louis.
July 2007	Science content expert is hired part-time in St. Paul.
August 2007	The core team reconvenes in St. Paul and discusses STEM concepts versus process.
September 2007	Rebecca Dyasi presents at the CDT meeting in St. Louis. There is no discussion of *Big Ideas*.
December 2007	PIE workshops in St. Paul are attended by SMM Learning Places staffs. A separate workshop is attended by LP Teens in St. Paul.
February 2008	Evaluation report is submitted on teens' understanding of STEM. The discussion of *Big Ideas* reopens in response to the report for one conference call and is dropped again.
February 2008	St. Louis LP program manager attempts to attend IFI in San Francisco, but has to reschedule for May 2008 due to illness. Other St. Louis LP staffs attend GEMS workshop in Oakland.
March 2008	PI and project staffs from St. Louis and St. Paul attend a PIE workshop at Explora in Albuquerque.
March 2008	Rebecca Dyasi provides a workshop in St. Louis as part of the SLSC speaker series. Learning Places staffs attend.