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

Summative Evaluation
Executive Summary

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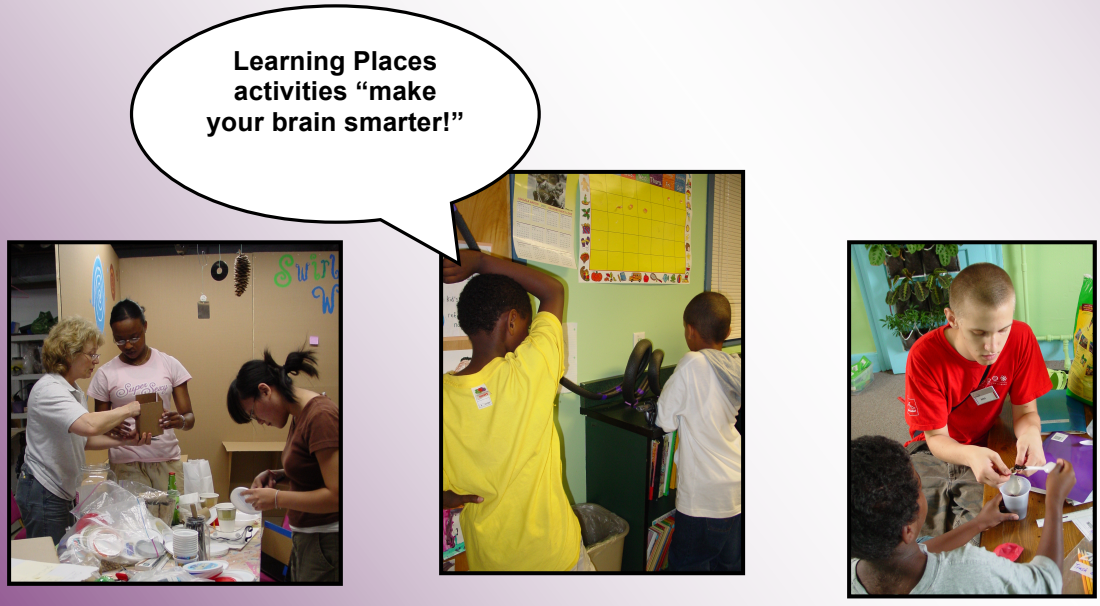

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EXECUTIVE SUMMARY

"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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