

STARBASE Minnesota follow-up study

Long-term program impact and community supports available to sustain learning

STARBASE Minnesota is a week-long science, technology, engineering, and math (STEM) program for students in fourth and fifth grades. Students solve scientific and engineering challenges through a hands-on curriculum in a technology-rich aerospace environment. Established in 1993, the program aims to increase the STEM-related knowledge, skills, and interest of urban youth for greater academic and lifelong success. More than 30 Minneapolis and St. Paul elementary schools partner with STARBASE Minnesota each year. The program hosts entire grade levels within schools during the school year and is located at the 133rd Airlift Wing of the Minnesota Air National Guard Base. STARBASE Minnesota is funded in large part by the U.S. Department of Defense STARBASE program, and is sponsored by the Minnesota National Guard. STARBASE Minnesota contracted with Wilder Research to conduct a follow-up study of participants to assess the program's long-term impact on their academic achievement and interest in STEM.

Study design

The study was unique in its rigorous matched-comparison design. Former STARBASE students were matched one-to-one with demographically and academically similar peers who did not participate in the program. Long-term program effects were examined through analysis of differences between these two groups on student outcome measures. Differences were further explored based on cohort, dosage, and demographic characteristics. At the time of the study, STARBASE was offered to fourth- and sixth-grade students, and those attending in fourth-grade only constituted the low-dosage group and those attending in both grades the high-dosage group.

Wilder Research has conducted the study in two phases. Phase I followed-up on three cohorts of Saint Paul Public Schools students who participated in STARBASE as 4th-grade students and were enrolled as 10th-, 11th-, or 12th-grade students during the 2008-09 school year. Program impacts were investigated related to high school students' interest, motivation, knowledge, and skill development in STEM, as well as their career interest in STEM including the military. Phase II followed-up on the latter two cohorts again in fall 2010, assessing impact on high school graduation, college enrollment, and interest and involvement in STEM during college. Information was also compiled on opportunities available in the local STEM community for students to continue their learning after STARBASE. Phase II is the focus of this summary and the report on which it is based.

Phase II data sources

Data for the Phase II study were obtained from several sources. College enrollment data was obtained from the National Student Clearinghouse, and high school graduation data from the Minnesota Department of Education. Wilder Research also administered a Web-based survey to gather information on college students' long-term interests and engagement in STEM following their participation in STARBASE. To assess program availability and gaps in the broader local STEM community, Wilder Research conducted a STEM program inventory as well as key informant interviews with local STEM leaders. Finally, data on students' military enrollment was provided by a U.S. Air Force official.

“STARBASE Minnesota is a 501(c)3 nonprofit organization whose purpose is to inspire and educate inner-city youth in science, technology, engineering, and mathematics.”

Overall findings

Taken together, Phase I and Phase II findings suggest possible long-term program impacts on students' high school graduation; college enrollment; and interest in STEM areas, and technology in particular. Because differences between STARBASE and comparison students were significant in some but not most cases, results should be viewed as promising but not definitive. Survey results also indicate that former STARBASE students have very positive feelings about the program even a decade later.

STARBASE appears to enhance students' STEM-related interests, yet there may be gaps between their interests and ability to continue pursuing those interests following STARBASE. Former STARBASE students who were enrolled in college in fall 2010 generally indicated STARBASE increased their STEM interest or understanding, but a majority said they did not participate in other STEM activities after STARBASE. Further, key informants described a number of barriers to accessing local STEM programs faced by underserved populations such as the urban students targeted by STARBASE. The STEM program inventory compiled as part of this study gathered information on 171 STEM programs or organizations, including 109 serving elementary, junior high, or high school students in St. Paul. This information can be used by program staff to help connect STARBASE graduates to ongoing STEM learning opportunities.

Beyond contributions to the STARBASE program's understanding of its own impacts, the study has the potential to contribute valuable information to the broader local STEM community. Key informants conveyed a keen interest in enhancing networking and collaboration within Minnesota's STEM community. In fact, the Phase II study coincided with early development of the Minnesota STEM Network, a new statewide network working to increase the state's effectiveness in providing STEM education. In this sense, the study is nicely timed to contribute valuable information to momentum toward enhanced networking and collaboration in the broader local STEM community that could help support students' STEM interests.

Findings by outcome area

Following are highlights of specific findings within each outcome area:

High school graduation

ON-TIME HIGH SCHOOL GRADUATION (N=415)



- Overall, former STARBASE participants appeared to have higher on-time high school graduation rates than comparison students (81% vs. 75%).
- Differences between the groups were not significant except in the comparison of high-dosage (81%) to comparison students (70%) in Cohort 2 graduating from high school on time.
- For context, in 2009 the four-year, on-time graduation rate for the St. Paul Public School District overall was 65%. This figure differs from the graduation rate reported for the STARBASE study sample in that it excludes students who transferred out of the district.

College enrollment

COLLEGE ENROLLMENT BY FALL 2010 (N=416)



- Results suggest that STARBASE participants have an increased likelihood of enrolling in college. Overall, 60% of STARBASE and 52% of comparison students enrolled in college by fall 2010.
- Differences were not significant except in the low-dosage comparison. A significantly higher percentage of low-dosage STARBASE students (71%) enrolled in college than their matched pairs (43%).

- Results also suggest program impacts for low-income students and minority students. A significantly higher percentage of low-income STARBASE than comparison students attended college (63% vs. 52%). This suggests that STARBASE may increase low-income students' likelihood of enrolling in college.
- Higher percentages of Black and Asian or Pacific Islander STARBASE students enrolled in college than their matched pairs, although those differences were not significant.
- STARBASE students also appeared to have an advantage over comparison students on a few protective factors associated with future degree completion, such as immediate college enrollment following high school graduation, although differences were not significant.

Participant feedback

Wilder Research conducted an online survey of former STARBASE participants attending college in fall 2010. Thirty-six students responded to the survey, providing information on their current interests and career plans, and reflecting back on their experience with STARBASE and the program's impact on them personally.

- A decade after their participation, almost all students (97%) said STARBASE was a valuable learning experience.
- Most (72-78%) said STARBASE increased their interest in STEM, or helped them understand those areas better.
- Those who indicated STARBASE increased their interest in STEM areas were asked about each area separately. Almost all (96%) indicated the program increased their interest in technology, followed by engineering and science (81-85%) and math (58%).
- Although based on a small sample, students' attribution of an increased interest in technology to STARBASE resonated with the Phase I finding that in high school STARBASE students had a stronger interest in technology than comparison students.

WHAT PARTICIPANTS SAY 9-10 YEARS LATER

“ I gained the knowledge of science, math, technology, and engineering through STARBASE at a young age, and that was something important for me.

The most important thing I gained was learning that science is not just about minerals and rocks, but airplanes, space, and just about everything else is a part of science.

The most important thing I gained from STARBASE participation was understanding that technology is infinite.

I remember creating [callsigns], touring the planes, and doing mini experiments during that whole week at STARBASE.

I gained the experience of learning something non-traditional outside of the classroom. Although I was learning a lot, I didn't feel like it because I was having fun while learning.

It was really fun, and it really helped me understand better the science behind it all.

I gained a respect and a better understanding of science and math that alleviated most of my fears about learning the topics.

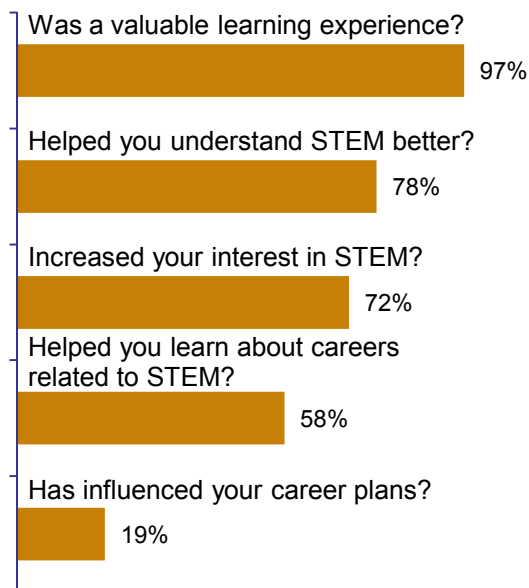
STARBASE provides a great opportunity for kids to explore science and in some cases find something that they would like to do in their careers.

I look at all the things that interested me at STARBASE and think about if I would like to do something like that in the future.”

- A majority (58%) reported that STARBASE helped them learn about STEM-related careers, although fewer indicated the program had actually influenced their career plans (19%).
- Phase I results also suggested the program helps students learn about different STEM career options, with nearly three-quarters of students in high school at the time reporting that STARBASE helped them learn either a lot or some about STEM-related careers.
- Students were asked to reflect on the most important thing they gained from participation in STARBASE. One in four students described an appreciation of science or STEM areas or an understanding of scientific principles. The top five responses also included an appreciation for or knowledge of technology specifically, knowledge of their own personal interests or learning style, a fun experience or the joy of exploration, and experience working on a team.

PERCEPTIONS OF STARBASE 9-10 YEARS LATER (N=36)

Do you think STARBASE...



STEM program inventory

Wilder Research conducted a STEM program inventory to compile information on programs available to support and foster continued STEM learning, achievement, and career exploration after students exit the STARBASE program. For study purposes, the inventory emphasized programs serving 4th- through 12th-grade students in the St. Paul area. Information compiled through the inventory documents a range of opportunities available to former STARBASE participants and other area students.

- The final STEM program inventory includes information on 171 programs or organizations, including 134 serving St. Paul and 109 serving elementary, junior high, or high school students in St. Paul.
- Science was the most frequently reported STEM program area (reported by 75% of all programs), although engineering (59%), technology (42%), and math (38%) were also fairly well represented.

Key informant interviews

In summer and fall 2010, Wilder Research staff conducted 28 key informant interviews with 29 representatives of local STEM organizations to identify areas of need or gaps in local STEM programs and supports.

- Despite program availability, key informants perceived a number of barriers to accessing available programs for underserved students such as the urban students in STARBASE Minnesota's target population. These included transportation, cost, awareness of available opportunities, not having a champion of STEM programming within their school, competing demands on time, language and cultural barriers, and other challenges.
- Key informants described gaps in participation of several groups, including minority populations, girls, students from low-income families, students perceived as "at-risk" for various reasons, and teenagers.

- Key informants also perceived gaps in local STEM programming. They suggested programming could be enhanced by providing more engineering-focused, college-preparation, career-readiness, interdisciplinary, and service-learning opportunities; using technology to engage students in STEM learning; strengthening classroom STEM curricula and teachers' instructional capacity; integrating longer-term projects; and providing students with demographically similar role models.
- Key informants perceive many important benefits of collaboration, and great potential for advancement through enhanced collaboration and networking.

Issues to consider

On a program level, Wilder Research's follow-up study provides STARBASE Minnesota with valuable insights about the program's long-term impact. On a community level, the study contributes information on existing programming, gaps, and opportunities for collaboration that may be valuable to the broader local STEM community. Based on study findings, following are several program- and community-level considerations that may be instructive to STARBASE staff and other STEM practitioners. Finally, possible directions for any future follow-up studies of STARBASE Minnesota participants are presented.

Program considerations

Sustaining students' STEM interests and learning. Taken together, results of the college-student survey and key informant interviews suggest there may be a gap between interest in STEM-related programming and ability to access such programming for students who face income, cultural, or other barriers. STARBASE staff recognize the importance of sustaining their students' STEM interests and learning after they exit the program, and the STEM program inventory emerged from this recognition. Program staff intend to use this information to help connect their graduates to opportunities after they complete STARBASE.

Sharing expertise. Study findings suggest that STARBASE Minnesota has expertise in a couple of areas cited by key informants as gaps in local STEM programming, such as technology integration, career exposure, and classroom integration. These findings suggest a potential role for STARBASE Minnesota in the larger STEM community to serve as a mentor or role model for other programs looking to strengthen these areas. Mechanisms for sharing this knowledge are already in place given the STARBASE Minnesota Executive Director's and board's active involvement in the Minnesota STEM Network.

Community considerations

Connecting students to programs. The STEM program inventory documents a range of opportunities available to area students, yet key informants suggested there are underserved populations that face barriers to access. Information compiled through the inventory is being shared with the broader STEM community, and may ultimately form the basis of a system that can help practitioners, schools, and parents link students to accessible opportunities. As noted by key informants, increased collaboration among STEM practitioners or between STEM programs and other community groups may also enhance their ability to reach underserved populations.

Connecting practitioners to practitioners. Results of the key informant interviews suggest there is keen interest in increasing networking among practitioners and collaboration within and beyond the local STEM community. The STEM program inventory can



contribute to enhanced collaboration and networking by increasing awareness of existing opportunities and contact persons. In these ways the study is nicely timed to contribute to momentum toward networking and collaboration in the broader local STEM community.

Future study directions

Examining the impact of program dosage. Phase I study results suggested that a higher STARBASE dosage may result in a greater likelihood of a STARBASE impact. Phase II analyses were limited by the small size of the low-dosage group and possibly influenced by demographic differences between the low- and high-dosage groups, and this pattern was not observed in the second phase. Any future studies should continue to explore program impacts based on level of exposure.

Continued follow-up of Phase I Cohort 3. It also seems beneficial to consider continued follow-up of Cohort 3 from the Phase I study. These students were enrolled in 10th grade in 2008-09 and would graduate from high school in spring 2011 if graduating on time. This was the largest cohort from the initial study. It would be instructive to see whether STARBASE-comparison group differences in high school graduation and college enrollment rates would be consistent with the differences observed with the Phase II follow-up of Cohorts 1 and 2, as well as to examine Cohort 3 former participants' reflections on their STARBASE experience and possible influences on career choices.

Assessing impact on career choices. Additional follow-up is needed to make strong claims about any long-term program impact on students' career choices. Results of the Phase II survey of college students were limited based on the sample size and difficulties obtaining student e-mail addresses for some colleges. In following-up with college students in any future studies, researchers and program staff can work to identify other ways of contacting those students. Also, students were in their first or second year in college and may not have made a career choice yet. Longer-term follow-up would be needed to more fully assess any impact on career choice.

Assessing impact on military interest. The Phase I study found that significantly more STARBASE (46%) than comparison (31%) students indicated at least a little interest in joining the military in high school. Although not a core study question, data on military enrollment were collected as part of the Phase II study but should be viewed with caution due to limitations with the data. In any future studies, researchers and program staff can consider ways to better track participants' subsequent involvement in civilian or uniform military careers in association with strengthening the assessment of impact on STEM career choices in general. Better ways to match study participants with the Department of Defense database can be explored. For example, researchers can work with someone knowledgeable about the database at study onset to better understand the types of identifying information that would be needed to better match both STARBASE and comparison study participants.



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For more information

This summary presents highlights of the *Follow-up study of STARBASE Minnesota participants: Phase II* report. This report and other reports on related topics are available at www.wilderresearch.org.

For more information on STARBASE Minnesota, contact Executive Director Kim Van Wie at 612-713-2530.

This study was sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs and STARBASE Minnesota, Inc.

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MARCH 2011