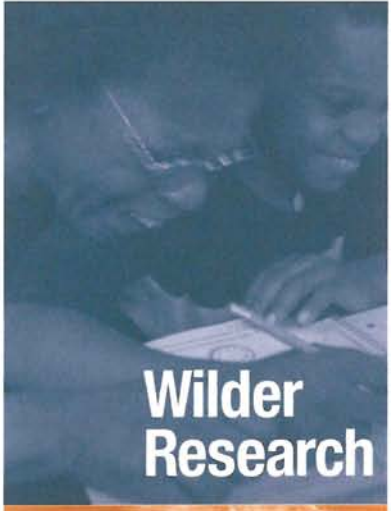

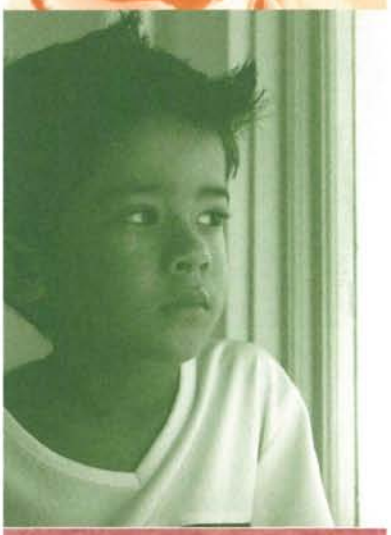

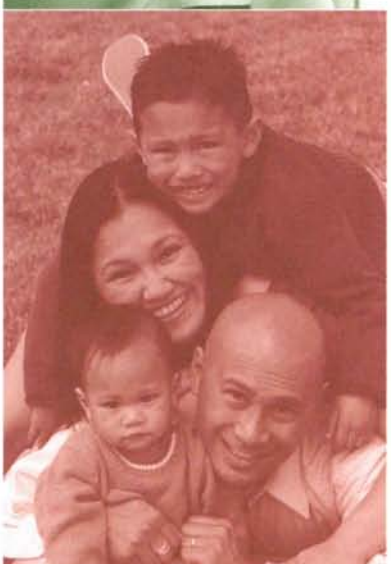

Follow-up study of STARBASE Minnesota participants

Program impact in high school

JUNE 2009

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June 2009

Prepared by:
Katie Broton and Dan Mueller

Wilder Research
451 Lexington Parkway North
Saint Paul, Minnesota 55104
651-280-2700
www.wilderresearch.org

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Figures

Acknowledgments

Wilder Research staff who contributed to the completion of this evaluation were as follows:
Mark Anton
Jacqueline Campeau
Rena Cleveland
Brandon Coffee-Borden
Paul Devereaux
Maria Gaona
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Summary

STARBASE Minnesota is a week-long science, math, technology, and engineering program for students in 4th and 6th grades. Students utilize hands-on curriculum and a technology-rich aerospace environment to learn about scientific problems. Established in 1993, the program's purpose is to increase the knowledge, skills, and interest of inner city youth in science, mathematics, technology, and engineering for greater academic and lifelong success. Over 30 Minneapolis and Saint Paul elementary schools partner with STARBASE Minnesota each year; some have been doing so for most of the program's history. The program hosts entire classrooms of 4th and 6th grade students during the school year and is located at the 133rd Airlift Wing of the Minnesota Air National Guard Base.

With funds from the Minnesota state legislature, the Minnesota Department of Military Affairs contracted with Wilder Research in January 2009 to conduct a follow-up study of STARBASE Minnesota participants. The purpose of the study is to assess the potential impact of participation in STARBASE Minnesota on high school students' interest, motivation, knowledge, and skill development in science, math, and technology. Additionally, interest in joining the military and participation in Junior Reserve Officers' Training Corps (JROTC) was examined.

Methods

The study sample included former STARBASE participants who were enrolled in 10th, 11th, or 12th grade in the Saint Paul Public Schools during the 2008-09 school year. A rigorous matched-comparison design was used in which the former STARBASE students were matched one-to-one with demographically and academically similar peers who did not participate in STARBASE. The effects of the STARBASE program were studied through analysis of differences between these two groups on student outcome measures (e.g., science, math, technology, and engineering interest level; academic performance). Additional analyses examined study measures by STARBASE dosage or level of exposure to the program (exposure in 4th and 6th grades vs. 4th grade only), current grade level, and older siblings' participation in STARBASE. Study measures were derived from three data sources: STARBASE student participant and program records, Saint Paul Public Schools student records, and a survey of senior high school students in spring of 2009. Statistically significant differences that emerged from the analyses are highlighted below.

Results

Survey

The survey questionnaire was divided into two sections. The first section applied to STARBASE students only and was comprised of questions directly related to STARBASE Minnesota. The second part of the questionnaire applied to both STARBASE and comparison group students. The questions in this section were about students' interest and participation in science, math, technology, and engineering more broadly as well as future plans.

Learning about science, math, technology, and engineering and related careers

A majority of former STARBASE students reported that STARBASE had helped them understand science, technology, engineering, or math (STEM) either a lot or somewhat better based on a four-point scale (a lot, somewhat, a little, or none). Additionally, nearly three-quarters of students reported that STARBASE had helped them learn either a lot or some about STEM-related careers. More students who attended STARBASE in both 4th and 6th grades (high dosage) indicated that they learned either a lot of some about STEM subjects and related careers compared to those who attended in 4th grade only (low dosage).

Interest in science, math, technology, and engineering

Both STARBASE and comparison students rated their level of interest (a lot, some, a little, or none) in each of the following subjects: science, math, technology, and engineering. STARBASE and comparison students' responses were similar for science, math, and engineering, but more STARBASE than comparison students reported either a lot or some interest in technology. In fact, nearly half of STARBASE students indicated that they have a lot of interest in technology compared to about one-third of comparison students.

Future military plans

More STARBASE than comparison students indicated an interest in joining the military. Nearly half of STARBASE students reported having at least a little (i.e., a lot, some, or a little) interest in joining the military, including 6 percent who reported a lot of interest. Three in 10 comparison students indicated they have at least a little interest in joining the military, including 5 percent who indicated a lot of interest.

Dosage

Although only sometimes statistically significant, a discernable pattern emerged when differences between high dosage and low dosage STARBASE subgroups were examined throughout the survey. For most survey items, more high dosage than low dosage

STARBASE students indicated greater interest and participation in STEM-related subjects and activities. Analyses indicated statistically significant differences between high and low dosage students on the following measures: STARBASE helped in understanding science, math, technology, or engineering better; STARBASE helped in learning about careers related to science, math, technology, or engineering; and currently participate in activities or programs related to science, math, technology, or engineering. While consistent throughout the survey, this high dosage finding should be considered with caution as the differences between high and low dosage subgroups are often small and there may be other contributing factors that were not included in the analysis conducted.

School records

The study also examined the courses taken and academic achievement of students in junior and senior high school. STARBASE and comparison students performed very similarly on these school record-based outcome measures. Three statistically significant differences emerged, but these differences could simply be due to chance, rather than a program impact, because of the large number of statistical tests conducted. The three statistically significant differences in which STARBASE students outperformed comparison students include the following:

- Junior high school grade average in science
- 10^{th} grade algebra 2 completion
- Senior high school attendance

These differences appear to be isolated findings in the sense that other differences in favor of STARBASE participants were not found between the groups on similar indicators.

Dosage

Similar to survey results, examination of student record-based measures over time suggested a very modest pattern of STARBASE students with a high dosage performing slightly better on more measures than those with a low dosage. This pattern was seen in the indicators measured in junior high school and 9^{th} grade, but did not continue in 10^{th} grade or after. This very modest pattern suggests that a higher dosage of STARBASE may be influencing students' course choices and academic performance to a slight extent.

Potential areas for further program development

Past research has shown that even with programs that have a particular emphasis on academic achievement, it is often difficult to observe any measurable differences in academic outcomes (Wimer, 2006). Previous short-term studies of STARBASE Minnesota (Van Wie, 2006) and STARBASE Atlantis (Lee-Pearce, et al., 1998) showed initial program effects, including increased understanding of science and math concepts. However, this study differs from previous STARBASE studies as it focused on students who participated in STARBASE four to eight years ago. The number of years since program participation and the limited amount of program exposure led us to anticipate a low program impact, so it is not surprising that school record-based data yielded few statistically significant differences. Alternatively, the survey data suggest limited program impact over time, which has the potential to be strengthened with further STARBASE exposure or reinforcement of content. The issues to consider below focus on ways to strengthen or sustain short-term program effects over time. Program staff and stakeholders may want to consider these issues in future program planning and development.

Dosage

There are some indications that a higher STARBASE dosage (4th and 6th grades vs. 4th grade only) may result in a greater likelihood of a STARBASE impact, even though a program impact wasn't detected on many of the study indicators. Results showed that higher dosage was linked with stronger outcome results on some measures, especially survey items that measure perceptions of STEM-related learning and reports of STEM-related activities. Additionally, the pattern was seen in some academic performance measures, and while very modest, it is fairly consistent throughout junior high school and 9th grade. These results suggest that, at a minimum, the program would *not* want to reduce the dosage or level of program exposure, and might consider ways to increase it.

Integration with classroom curriculum

STARBASE has taken key steps to align and integrate its programming into the classroom. Continuing to build on and review these efforts should help ensure congruence with what is being covered in the classrooms at the schools served. STARBASE may also want to consider other ways to work with teachers, schools, or other STEM organizations to reinforce program content through such things as teacher training or additional follow-up materials for teachers and students as a way to enhance program effects. Perhaps program effects could be enhanced by working even more closely with participating teachers and schools. Maximizing the congruence and integration of the two curricula and providing

other tools or STEM experiences that build on students' initial exposure may help to strengthen the impact of the program experience on students.

Longer term effects of interests stimulated

Survey results of former STARBASE students in high school suggest that STARBASE increased their interest in STEM and the military. Creating or increasing student interest in STEM or the military may have longer term effects, even though such effects are not seen clearly in the shorter term. That is, interests stimulated by the program may be manifested later in fields of study in college or career choices (Tai, et al., 2006).

Introduction

Program description

STARBASE Minnesota is a week-long science, math, technology, and engineering program for students in 4th and 6th grades. Students utilize hands-on curriculum and a technology-rich aerospace environment to learn about scientific problems. Established in 1993, and academically strengthened in 2000, the program's purpose is to increase the knowledge, skills, and interest of inner city youth in science, mathematics, technology, and engineering for greater academic and lifelong success. During the 20-hour program, students experiment with rockets, wind tunnels, and vacuum pumps; explore aircraft; learn about Newton's laws, flight, and space; conduct computer simulations; and use engineering software to design and manufacture aerospace equipment. Students are taught by certified teachers, licensed in the state of Minnesota, and take pre- and post-tests at the beginning and end of the program. These pre- and post-tests gauge career interests, knowledge, and application of skills as well as interest and positive attitudes toward science, math, technology, and engineering. Additionally, school teachers are given a manual that contains one mandatory pre-STARBASE lesson, additional lesson plans, a curriculum overview, state and national standards alignment, homework, and other resources for their class.

Over 30 Minneapolis and Saint Paul elementary schools partner with STARBASE Minnesota each year; some have been doing so for most of the program's history. The program hosts entire classrooms of 4th and 6th grade students during the school year and is located at the 133rd Airlift Wing of the Minnesota Air National Guard Base. There is no fee to participate, but schools are responsible for providing transportation, lunch for their students, and chaperones. Funding is provided primarily by the Department of Defense and supported by the Minnesota National Guard. Partners including Northwest/Delta Airlines, General Mills, Medtronic, Seagate, Ecolab, Lockheed Martin, and others provide volunteer and in-kind support. Additionally, between 2000 and 2006, STARBASE Minnesota provided programming to 8th grade students who were enrolled in Saint Paul Public Schools summer school for academic reasons. At the request of the school district, this STARBASE summer program emphasized the reinforcement of math concepts, not broad-based STEM learning, and was not as academically rigorous as the 4th and 6th grade curriculums. Eighth grade participation was not considered in this study for these reasons and because of the small number of participants.

Study purpose

STARBASE Minnesota utilizes a program logic model that defines the need, solution, and expected outcomes of the program for students and teachers (see Appendix). The logic model identifies a number of expected initial outcomes during the STARBASE program, intermediate outcomes within a year of participating in STARBASE, long-term outcomes within junior and senior high school, and a long-term vision for beyond high school. Some research on other STARBASE programs has been conducted to examine intended initial impacts (Lee-Pearce, et al., 1998), and STARBASE Minnesota has conducted some small follow-up surveys to gauge intermediate and long-term impacts (Van Wie, 2001, 2006). The purpose of this study is to learn more about the expected long-term outcomes. With funding from the Minnesota state legislature, the Minnesota Department of Military Affairs contracted with Wilder Research in January 2009 to conduct a follow-up study of STARBASE Minnesota participants. Wilder Research assessed the potential impact of program participation on high school students' interest, motivation, knowledge, and skill development in science, math, and technology. Additionally, interest in joining the military and participation in Junior Reserve Officers' Training Corps (JROTC) was examined.

Student outcomes measured in senior high school include:

- Science, math, technology, and JROTC courses taken, including honors courses
- Academic performance, especially in science, math, technology, and JROTC
- Math achievement test scores
- Percentage of courses passed
- Attendance rate
- Interest level in science, math, technology, and engineering
- Plans for further education and career plans

Student outcomes measured in junior high school include:

- Science, math, and technology courses taken, including honors courses
- Academic performance, especially in science, math, and technology
- Math achievement test scores
- Percentage of courses passed

Study methods

This section provides a brief description of study methods. The section begins by describing the study design and sample including descriptions of the STARBASE and comparison groups. The remaining portions describe the sources of information used in the study and the data analysis procedure. Further information regarding the matched comparison group and construction of study indicators can be found in the "technical details of study methods" section in the Appendix.

Study design

A rigorous matched-comparison design was used in which former STARBASE students were matched one-to-one with demographically and academically similar peers who did not participate in STARBASE. The effects of the STARBASE program were studied through analysis of differences between these two groups on student outcome measures.

STARBASE group

The study includes three cohorts of Saint Paul Public Schools (SPPS) 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. For purposes of study eligibility, students were required to participate in STARBASE in 4th grade to maximize their potential exposure or dosage, as they could have participated again in 6th grade and even in the summer before 8th grade. Additionally, these students must have been enrolled in SPPS in 3rd grade when they took achievement tests in math and reading.

We had several reasons for using these criteria. The Saint Paul school district was chosen because the majority of students served by STARBASE come from this district and it seems likely that study results found in Saint Paul would apply to Minneapolis since the two districts serve similar student populations. Additionally, these student cohorts participated in STARBASE after it was strengthened academically and after the STARBASE student record system was improved, which was important to the feasibility of this study. It should also be noted that this study group likely represents a more stable student population, as students were required to be enrolled in SPPS in 3rd and 4th grades as well as in high school and it therefore excludes more transient students.

Comparison group

STARBASE students were compared to demographically and academically similar SPPS students who did not participate in the program using a matching procedure described below. This procedure enables us to credibly determine what effects STARBASE may

have had on the identified student outcome measures. To be eligible for the comparison group, students must have been enrolled in SPPS as a 10th, 11th, or 12th grade student during the 2008-09 school year and during their 3rd and 4th grade years. Additionally, in 4th grade, they could *not* have attended an elementary school that participated in STARBASE or had a special emphasis on math, science, or technology (e.g., Crossroads Science). Students who met these criteria were then screened using STARBASE program records to ensure they hadn't participated in the program.

Matching procedure

A multi-stage matching methodology was used to match STARBASE and comparison students on nine observable characteristics. Student pairs were required to match on the following four characteristics: grade level in 2008-09, high school attended in 2008-09, 3rd grade math achievement test level score, and 3rd grade reading achievement test level score. Additionally, pairs had to match on at least one of the following five characteristics in 4th grade: economic status, English Language Learner status, special education status, sex, and race/ethnicity. Based on these criteria, 442 of 501 (88%) eligible STARBASE participants were matched to a comparison student. Of the 442 matches, 7 in 10 (69%) student pairs matched on all nine characteristics, and an additional 23 percent matched on seven or eight characteristics. The study sample was composed of these 884 students. The matching technique used and the high match rate on all nine characteristics help to ensure that differences between the STARBASE and comparison groups are not likely due to demographic or academic characteristics. STARBASE students who were not matched are least typical with regard to this combination of characteristics and were not included in the sample. More details on this procedure and matching characteristics can be found in the Appendix ("Technical details of study methods" section).

Measurement

Three sources of data were used in this study: STARBASE student participant and program records, SPPS student records, and a survey of senior high school students. Indicators derived from these data sources for study use are described below.

STARBASE records

In 1998 and 1999, the STARBASE Minnesota student record system was substantially improved, allowing Wilder Research to utilize a rigorous matched-comparison study design. The STARBASE database provided reliable information on student participation and dosage or level of exposure to the program. Additionally, comparison students were screened to ensure they hadn't participated in the program. Finally, STARBASE recorded students' unique identification (ID) numbers assigned by the school district, which

allowed students' school records to be examined four to eight years after program participation. The STARBASE student record system included the following information:

- Student name and ID number
- Student grade level and dates of program participation
- Student level of STARBASE dosage (participation in 4th, 6th, 8th grades)

STARBASE also provided program information on which elementary schools and grade levels participated in the program each year.

Saint Paul Public Schools records

Saint Paul Public Schools records were also essential to the design of this study. The records provided information used to match students and construct study indicators. SPPS provided record data for the three cohorts of students from school years 2005-06 through 2007-08 and the first half of 2008-09 as shown in Figure 1 below. Information was also provided when students were in 3rd and 4th grades for matching purposes.

1. School record data available

	Grade level		
School year	12th grade cohort	11th grade cohort	10th grade cohort
2008-09[a]	12	11	10
2007-08	11	10	9
2006-07	10	9	8
2005-06	9	8	7

[a] *Data were available for the first semester only.*

Saint Paul Public Schools records include the following information:

- Student ID number
- Student demographics (in 4th grade)
- 3rd grade math and reading achievement test results (Minnesota Comprehensive Assessment – i.e., MCA)
- School attended in 4th grade (and 6th grade for some cohorts)
- School year in which attended 4th grade

- School attended in 2008-09
- Grade level in 2008-09
- Courses taken in senior high school (and junior high school for some cohorts)
- Grades in senior high school courses (and junior high school for some cohorts)
- Math achievement test results in senior high school (MCA II) (or junior high school MCA results for some cohorts)
- High school attendance in 2007-08

High school student survey

A total of 716 STARBASE and comparison students at four SPPS senior high schools were identified to participate in the self-administered survey. Topics covered by the survey include the following (see Appendix for survey questionnaire):

- Ratings and comments about STARBASE participation and what it may have meant
- Activities or programs in which the student was currently participating or had participated related to science, math, technology, or engineering or the military
- Level of interest in science, math, technology, and engineering, and if STARBASE participation influenced this interest level
- Future educational and career plans, including interest in joining the military

The survey response rate was 71 percent, as 507 out of 716 students across all three cohorts completed the survey in spring of 2009. Furthermore, 170 matched student pairs remained intact representing two-thirds (67%) of all completed surveys, and these 340 surveys were included in the survey analysis. Further analyses indicated that students who were included in the survey analysis have similar academic and demographic characteristics as those who were not included in the survey analysis. However, slightly more English Language Learner and Asian or Pacific Islander students were included in the survey analysis compared to those who were not included (see "technical details of study methods" in the Appendix).

Data analysis

In this study, the primary focus of data analysis was the assessment of differences between STARBASE and comparison students on student outcome measures (e.g., science, math, and technology courses taken; academic performance). Although school record and survey data were analyzed separately, both utilized the same approach. First, analyses were conducted to determine any statistically significant differences between the two groups in which STARBASE students performed better than the comparison group. A statistically significant difference is one that exceeds the amount of variation that could be expected by chance; that is, there is less than a 5 percent probability that the finding resulted by chance. If a statistically significant difference emerged between the STARBASE and comparison groups, further analyses were conducted to learn more about that difference, as described below.

Indicator measures with statistically significant differences were further examined by dosage or level of exposure to STARBASE (participation in 4th grade only vs. participation in 4th and 6th grades), cohort (i.e., 10th, 11th, or 12th grade), and whether or not an older sibling also participated in STARBASE (see "technical details of study methods" in the Appendix). STARBASE students in each subgroup (e.g., high dosage, 11th grade cohort) were compared to their match (i.e., demographically and academically similar peers) in these follow-up analyses. For survey items to which only STARBASE students responded, differences in dosage, cohort, and sibling participation were analyzed within the STARBASE group.

Differences in dosage, cohort, and older siblings' STARBASE participation were explored since the program is particularly interested in learning how these factors influence student outcomes, if at all. Specifically, cohort was analyzed because in 2000, steps began to be taken to academically strengthen the STARBASE program. This is the year that students in the 12th grade cohort participated in STARBASE's 4th grade program. Fuller effects of this strengthening may have been experienced by later cohorts (those in 10th and 11th grades in 2008-09). To assess any potential differences related to this academic strengthening, outcome measures were analyzed by cohort.

Results

Survey

The survey questionnaire was divided into two sections. The first section applied to STARBASE students only and was comprised of questions directly related to STARBASE Minnesota. For these items, differences in dosage, cohort, and older siblings' STARBASE participation were analyzed within the STARBASE group, and statistically significant differences between subgroups are reported. The second part of the questionnaire applied to both STARBASE and comparison group students. The questions in this section were about students' interest and participation in science, math, technology, and engineering more broadly as well as future plans. Responses to these survey items were analyzed between groups (STARBASE vs. comparison), and any statistically significant differences were further analyzed by dosage, cohort, and older siblings' STARBASE participation.

STARBASE group

Students were asked if they participated in STARBASE in elementary school, and almost all students (92%) that program records indicate participated in STARBASE in 4th grade reported doing so. Students were then asked to briefly write what they remember most about participating in the program, and their responses were categorized by theme. The most common student response theme was building and launching rockets (43%). Other frequent responses included learning about rockets and airplanes (24%), seeing airplanes and helicopters in-person (23%), and the computer flight simulation (22%). Additional response themes can be found in the Appendix (Figure A5).

Learning about science, math, technology, and engineering and related careers

Based on a four-point scale (a lot, somewhat, a little, or none), 63 percent of students reported that STARBASE helped them understand science, technology, engineering, or math (STEM) either a lot or somewhat better. Follow-up analyses indicated that more high dosage (4th and 6th grade participation) than low dosage (4th grade participation only) students reported that STARBASE helped them understand STEM subjects better, and this difference was statistically significant ($p<.05$) (Figure 2). Further analyses by cohort and sibling participation did not yield any statistically significant differences.

2. How much better STARBASE helped students understand science, math, technology, or engineering by dosage*

	N	A lot	Some	A little	None
STARBASE	155	18%	45%	33%	5%
High dosage	134	19%	46%	31%	3%
Low dosage	21	10%	33%	43%	14%

* *p<.05*

Note. *High dosage includes students who participated in STARBASE in both 4th and 6th grades. Low dosage includes students who participated in STARBASE in 4th grade.*

Nearly three-quarters (73%) of students indicated that STARBASE helped them learn either a lot or some about careers related to science, math, technology, or engineering based on the same four-point scale (a lot, some, a little, or none). Further analyses showed a statistically significant difference between dosage levels ($p<.05$). Specifically, when the categories of some, a little, and none were combined, more high dosage (31%) in comparison to low dosage students (0%) indicated that they learned a lot about STEM-related careers ($p<.01$) (Figure 3). There were no statistically significant differences when examined by cohort or older siblings' STARBASE participation.

3. How much STARBASE helped students learn about careers related to science, math, technology, or engineering by dosage*

	N	A lot	Some	A little	None
STARBASE	155	27%	46%	21%	6%
High dosage	134	31%**	44%	19%	5%
Low dosage	21	0%**	57%	33%	10%

* *p<.05*

** *p<.01*

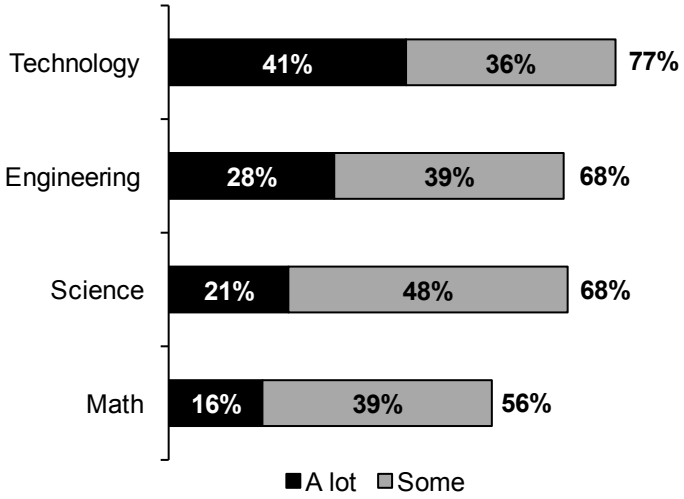
Note. *High dosage includes students who participated in STARBASE in both 4th and 6th grades. Low dosage includes students who participated in STARBASE in 4th grade.*

Increased interest in science, math, technology, and engineering

Students were asked to rate how much STARBASE increased their interest in science, math, technology, and engineering on a four-point scale (a lot, some, a little, or none). Over three-quarters (77%) of students indicated that STARBASE increased their interest in technology either a lot or some. About two-thirds (68%) of students reported that

STARBASE increased their interest in engineering and science either a lot or some, and the majority (56%) reported that STARBASE increased their interest in math either a lot or some. While the majority of students reported that STARBASE increased their interest in all STEM subjects either a lot or some, the increased interest in technology was especially strong. Four in 10 students reported that STARBASE increased their interest in technology a lot (Figure 4). Follow-up analyses did not show any statistically significant differences between subgroups.

4. How much STARBASE increased students' interest in science, math, technology, and engineering (N=155)



Note. *See Figure A6 for more details.*

STARBASE experience and influence

The increased interest in STEM subjects stimulated by STARBASE led some students (18%) to get involved in STEM-related activities or programs. Examples of STEM-related activities and programs that students did get involved in due to STARBASE include the following:

> My job at the Science Museum; it's called the Invention Crew and we work with all of that.
>
> I'm taking engineering classes at college.
>
> I am in Sky Pilot, a Saturday morning class.
>
> [I do] web design, audio recording, and video recording.
>
> I'm in the ACE (Architecture, Construction, and Engineering) Academy [at Johnson Senior High School].
>
> [I was in] Robotics Club in middle school.

Most students (82%) reported that STARBASE was a valuable learning experience, and 17 percent indicated they were unsure if it was. About one-quarter (26%) of students indicated that their participation in the program continues to impact them today, and 57 percent reported they were unsure if it did so. Students were asked to elaborate on how STARBASE continues to impact them today, and their responses were grouped by theme. Students' most common response was that they still use the knowledge and experiences gained at STARBASE (8%). Other students expressed that they learned about or want to pursue a STEM-related career, or learned about science, math, technology, or engineering in general (5%-6% each) (Figure A7). Examples of students' comments regarding the impact of STARBASE include the following:

> [While there,] I learned a lot about rockets, math, and science that I will never forget. I felt it got me ahead of others.
>
> STARBASE showed me a lot of things – not just building up my skills in math, technology, science, and engineering, but my leadership skills as well.
>
> It helped me with my problem solving abilities.
>
> STARBASE was my foundation for learning complex science and math skills that I didn't know of prior to the field trip.
>
> It opened my eyes to the current technology and caused me to wonder how future technology could be. It caused me to study technology.
>
> STARBASE was a fun, exciting way to learn about science, math, etc. It taught me that I can have a fun career doing science, math, etc.
>
> Having hands-on participation made me realize math, science, and engineering isn't the career I want.
>
> It made me join [Air Force] ROTC to possibly be a rocket scientist.

STARBASE and comparison groups

In this section, results are reported for each group (STARBASE and comparison) and it is noted if the difference between the groups was statistically significant. If the difference between the two groups was significant, follow-up analyses were conducted by dosage, cohort, and older siblings' STARBASE participation. These subgroup results are reported if statistically significant.

Interest in science, math, technology, and engineering

STARBASE and comparison students were asked to rate their level of interest (a lot, some, a little, or none) in each of the following subjects: science, math, technology, and

engineering. In most subject areas, students' responses were similar for both groups. For example, 27 percent of both STARBASE and comparison students indicated a lot of interest in science. However, there was a statistically significant overall difference in students' interest level in technology, as more STARBASE than comparison students reported a higher level of interest in technology ($p<.05$). To learn more about this difference, further analyses were conducted combining the three categories of some, a little, and none. When STARBASE and comparison students were compared on two categories, a lot of interest versus some or less, the difference was also statistically significant ($p<.01$). More STARBASE (49%) than comparison students (34%) indicated a lot of interest in technology (Figure 5).

5. Level of interest in science, math, technology, and engineering

Subject	Group	N	A lot	Some	A little	None
Technology*	STARBASE	168	49%**	32%	13%	6%
	Comparison	168	34%**	40%	22%	4%
Science	STARBASE	168	27%	48%	20%	5%
	Comparison	168	27%	44%	23%	6%
Math	STARBASE	167	27%	44%	20%	10%
	Comparison	167	29%	35%	25%	11%
Engineering	STARBASE	168	28%	30%	29%	13%
	Comparison	168	22%	35%	24%	19%

* *p<.05*

** *p<.01*

Further analyses split the STARBASE group by dosage, cohort, and older siblings' participation in STARBASE, and each subgroup was compared to their demographically and academically similar peers (i.e., one-to-one matched comparison). In each subgroup, more STARBASE than comparison students indicated a lot of interest in technology, although the difference was only statistically significant for the following: high dosage, 11th grade cohort, and those with an older sibling who participated in STARBASE (Figure 6). The statistically significant results should be considered with caution as some subgroups have similar percentage differences between STARBASE and comparison students (e.g., high dosage=16% difference and low dosage=15% difference), but one was significant (high dosage) and one was not, mostly likely due to differences in the size of the groups. Statistical significance is a function of the difference between the groups, the variability within groups, and the size of the groups.

6. A lot of interest in technology by subgroup

		N[a]	Percentage with a lot of interest in technology: STARBASE	Comparison	Significance
Dosage	High	142	49%	33%	**
	Low	26	54%	39%	ns[b]
Cohort	10th grade	84	52%	41%	ns
	11th grade	60	48%	32%	*
	12th grade	24	42%	17%	ns[c]
Older sibling was STARBASE participant	Yes	60	55%	28%	**
	No	108	46%	37%	ns

* *p<.05*

** *p<.01*

ns not statistically significant

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 142 STARBASE students were compared to 142 comparison students).*

[b] *Note that the percentage difference between STARBASE and comparison students in the dosage subgroup is similar for both high and low dosage students. However, there may not be enough power to detect a statistically significant difference in the low dosage category given the small sample size.*

[c] *Note that the percentage difference between STARBASE and comparison students in the cohort subgroup is similar for both 11th and 12th grade cohorts. However, there may not be enough power to detect a statistically significant difference in the 12th grade cohort given the small sample size.*

Note. *Response options include a lot, some, a little, or none. Response options some, a little, and none were combined for this analysis.*

Future military plans

Students were also asked to indicate how much interest they had in joining the military (a lot, some, a little, or none). Nearly half (46%) of STARBASE students reported having at least a little (i.e., a lot, some, or a little) interest in joining the military, including 6 percent who reported a lot of interest. Three in 10 comparison students indicated they had at least a little interest in joining the military, including 5 percent who indicated a lot of interest. The overall difference between the groups was statistically significant ($p<.05$), and further analyses were conducted combining the three categories of a lot, some, and a little. When comparing STARBASE and comparison students on two categories, at least a little interest and no interest in joining the military, the difference was also statistically significant ($p<.01$) as more STARBASE students indicated interest in joining the military (Figure 7).

7. Level of interest in joining the military*

	N	A lot	Some	A little	None**
STARBASE	140	6%	16%	24%	54%
Comparison	140	5%	14%	11%	69%

* *p<.05*

** *p<.01*

Next, the STARBASE group was split by dosage, cohort, and older siblings' STARBASE participation and compared to the respective comparison subgroup. More STARBASE than comparison students indicated at least a little interest in joining the military in all subgroups, and the results were statistically significant within four of the subgroups. Most interesting may be that 38 percent of 12th grade cohort STARBASE students indicated at least a little interest in joining the military compared to 5 percent of 12th grade comparison students ($p<.01$). A statistically significant difference was also found in the following subgroups: 10th grade cohort, high dosage, and those who did not have a sibling participate in the STARBASE program (Figure 8).

8. At least a little interest in joining the military by subgroup

			Percentage with a little, some, or a lot of interest in joining the military		
		N[a]	STARBASE	Comparison	Significance
Dosage	High	116	47%	30%	**
	Low	24	42%	33%	ns
Cohort	10th grade	70	56%	40%	*
	11th grade	49	37%	29%	ns
	12th grade	21	38%	5%	**
Older sibling was STARBASE participant	Yes	49	45%	33%	ns
	No	91	47%	30%	**

* *p<.05*

** *p<.01*

ns not statistically significant

Note. *Response options include a lot, some, a little, none, or don't know. Students who responded don't know were excluded. Response options a little, some, and a lot were combined for this analysis.*

Activities and experiences

Both STARBASE and comparison group students were asked about their current participation in STEM-related activities or programs and those related to the military. Current STEM program participation rates were very similar, as 12 percent of STARBASE students and 13 percent of comparison students reported participating in such a group. Examples of STEM programs in which students participated include Project Lead the Way, math league, small learning communities, career pathways, and pre-college programs. Slightly more STARBASE (13%) than comparison students (8%) reported participating in a military-related program, although this difference was not statistically significant. The most common military-related program in which students currently participate is JROTC.

About one-third of students in each group (33% STARBASE and 31% comparison) indicated that a past experience or activity (besides STARBASE) increased their interest in science, math, technology, or engineering. When asked to elaborate on this experience, the most common student response, regardless of group, was that a STEM-related class or lab at school piqued their interest in the field. Other common response themes included field trips, informal learning with friends or family, science fairs, and aerospace camp (Figure A8).

Favorite core subject

Based on four options (English, math, science, or social studies), students were asked to indicate their favorite core subject. Survey results indicated that the most common favorite core subject among both STARBASE and comparison students was math (34% STARBASE and 35% comparison). Science was a close second among STARBASE students (33%) and tied for second with English among comparison students (26% each). About one in five (22%) STARBASE students rated English as their favorite core subject, and fewer students in both groups indicated that social studies was their favorite (12% STARBASE and 13% comparison) (Figure A9). Differences between groups were not statistically significant, but it may be encouraging that a majority of all students rated math or science as their favorite core subject.

Future educational plans

A series of questions related to future plans were included in the survey, and it should be noted that students at various stages in their high school career (i.e., 10^{th}, 11^{th}, or 12^{th} grade) responded. There were no statistically significant differences between STARBASE and comparison students' responses to these questions. Students were asked to indicate what their plans were for taking more science, math, computer, or engineering classes in high school from a list of four options (yes, more than what's required; yes, only what's required; no; or don't know). Results were similar for both groups, but slightly fewer STARBASE students (41%) than comparison students (44%) indicated that they plan to

take more science, math, computer, or engineering classes than required. About 4 in 10 (42%) STARBASE students reported they were going to take the required amount of STEM courses in high school, and about one-third (33%) of comparison students chose this response. Fewer students reported they were not planning to take any more STEM classes or were unsure (18% STARBASE and 23% comparison) (Figure A10).

Almost all students (95% STARBASE and 94% comparison) indicated that they plan to attend either a two- or four-year college; others were unsure (4% STARBASE and 5% comparison). Nearly half of STARBASE students (47%) and slightly fewer comparison students (41%) reported that they plan to pursue a STEM-related career. Nearly half of students in both groups (46% each) reported they did not know if they were going to pursue a career in the STEM field. Additionally, students who indicated that they had an older sibling who participated in STARBASE were asked a follow-up question to see if that older sibling either majored in a STEM field in college or now has a job in this area. Results indicated that one of three (33%) siblings from the comparison group and one-quarter (25%) of the older siblings from the STARBASE group either majored in or had a job related to science, math, technology, or engineering.

Dosage

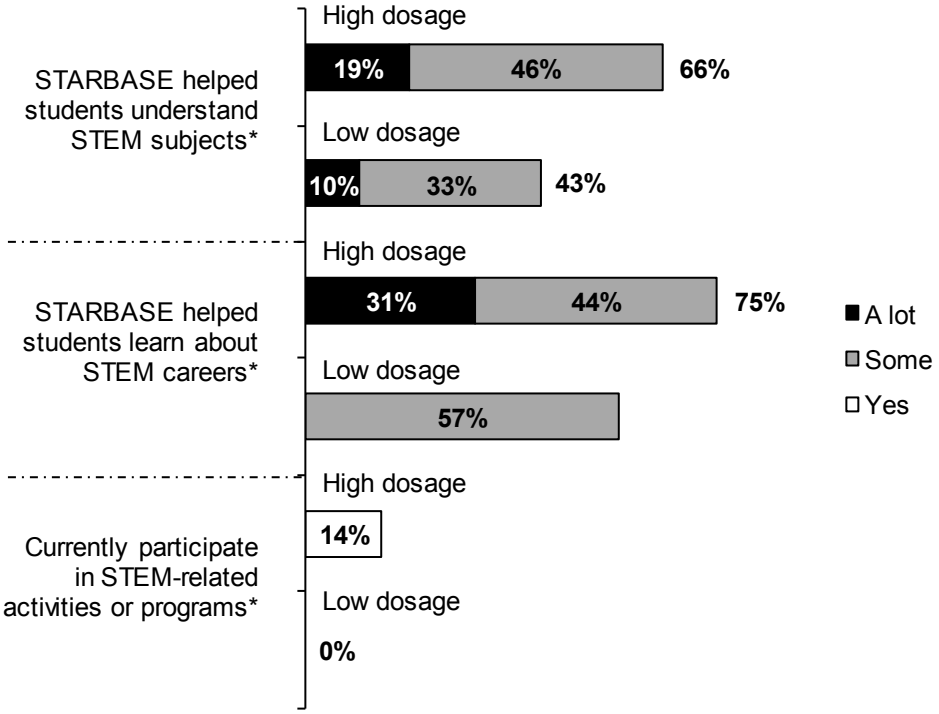
Although only sometimes statistically significant, a modest pattern emerged when differences between high and low dosage subgroups were examined within the STARBASE group only section of the survey, leading us to examine dosage differences throughout the entire survey. For most survey items, slightly more high dosage than low dosage STARBASE students indicated greater interest and participation in STEM-related subjects and activities. Further analyses indicated that these dosage differences were *not* likely due to demographic or academic differences between the high and low dosage subgroups (see "technical details of study methods" in the Appendix).

Analyses indicated statistically significant differences between high and low dosage students on the following measures (Figure 9):

- STARBASE helped in understanding science, math, technology, or engineering better
- STARBASE helped in learning about careers related to science, math, technology, or engineering
- Currently participate in activities or programs related to science, math, technology, or engineering

Additional dosage differences that were not statistically significant can be found in the Appendix (Figures A11-A21).

9. Differences in survey results by dosage



* *p<.05*

Note. *High dosage subgroup N=134 and low dosage subgroup N=21 for STARBASE helped students understand STEM subjects and learn about STEM careers. High dosage subgroup N=142 and low dosage subgroup N=26 for currently participate in STEM programs.*

In addition to learning about STEM-related careers, more high dosage (49%) than low dosage students (37%) indicated that they plan to pursue a STEM-related career, although this difference was not statistically significant (Figure A22). Learning about STEM careers and planning to pursue a STEM-related job are important indicators since some research suggests that experiences in elementary and middle school may have an important impact on future career plans. Specifically, there is some evidence that, of those who graduate from college, science-related career aspirations as youth increase the likelihood of a science-related major in college (Tai, et al., 2006). While consistent throughout the survey, this high dosage finding should be considered with caution, as the differences between high and low dosage subgroups are often small and there may be other contributing factors that were not included in the analysis. Survey items were also examined by cohort and older siblings' participation in STARBASE, but no patterns emerged.

School records

Analysis

This section utilized Saint Paul Public Schools student record data to examine outcome measures such as students' course selection and academic performance in science, math, technology, and JROTC courses as well as overall. Wilder Research analyzed outcome measures in junior and senior high school (i.e., 7th-8th grade records were examined separately from 9th-12th grade records). Additionally, outcomes were measured in 9th grade and 10th grade cumulatively (i.e., 9th-10th grade records) to determine if differences emerged at different points in students' academic careers. As indicated above, students fall into one of three cohorts based on their grade level in 2008-09. Researchers utilized the records of as many cohorts as possible for each set of outcomes measured. For example, when measuring outcomes from students' 9th grade year, the records of cohorts 10, 11, and 12 were used, but when analyzing outcomes based on students' senior high school career (i.e., 9th-12th grade), only the records of cohort 12 were used. A table summarizing the school record data analysis plan is shown in Figure 10 below.

10. School record data analysis plan

Grade level outcomes measured in	Grade levels included	Cohort
8th grade cumulative	7, 8	10
9th grade	9	10, 11, 12
10th grade cumulative	9, 10	11, 12[a]
12th grade cumulative	9, 10, 11, 12[b]	12

[a] *The 10th grade cohort was not included because data were available for the first semester only.*

[b] *Data were available for the first semester only.*

Indicator measures

The same set of indicators was measured in each of the four grade levels mentioned above, to the extent possible and appropriate. For example, junior high school students are unable to enroll in JROTC courses, so that indicator was not examined in the 8th grade cumulative analysis. The 8th grade cumulative (i.e., junior high school) outcome measures include a count of successfully completed courses, weighted grade average of courses, and percentage of courses passed (see "technical details of study methods" in the Appendix). Science, math, and technology courses were counted by department and overall as a group. Honors courses taken in all subjects, plus math and science honors courses in particular, were also counted. The weighted grade average was calculated for math and science courses

separately, then combined, and also for all courses taken, regardless of subject. The percentage of courses passed measure was analyzed combining math, science, and technology courses as well as for all courses (Figure A23). Finally, the highest level of math course passed (see "technical details of study methods" in the Appendix) was analyzed (Figure A24). For each of these junior high school indicator measures, the difference between STARBASE and comparison students was examined.

The indicators measured in 9th grade include the junior high school measures described above, plus a few additional measures. A course count and weighted grade average of JROTC courses, an honors technology course count, and technology weighted grade average were added in the high school indicator measures. Additionally, the number of lab sciences (i.e., biology, chemistry, and physics) students' successfully passed was counted. Finally, a benchmark indicator was included to determine the percentage of students who completed algebra 2 or a higher math course (Figures A25-A26). Again, the difference between STARBASE and comparison students, based on 9th grade records, was analyzed for each indicator measure.

The indicators measured in 10th and 12th grades cumulatively (i.e., 9th-10th grade and 9th-12th grade combined records) (Figures A27-A32) were nearly the same as those in the 9th grade analysis. Additions include a benchmark indicator determining the percentage of students who had completed all three lab sciences (i.e., biology, chemistry, and physics) and a STEM momentum measure (Figures A29, A32). This STEM measure combines students' highest math level and the number of lab sciences passed (see "technical details of study methods" in the Appendix).

Additionally, students' attendance from the 2007-08 school year was analyzed along with the most recent math achievement scores available – i.e., Minnesota Comprehensive Assessment (MCA) math results. For the 10th and 11th grade cohorts, the MCA 8th grade math test was analyzed, and for the 12th grade cohort, the MCA-II 11th grade math test was examined. STARBASE and comparison students' attendance and math scores were compared (Figures A33-A34).

Results from school record-based measures are only reported for statistically significant differences between the STARBASE and comparison groups. All measures, including those split by dosage and cohort, regardless of significance, are included in the Appendix (Figures A23-A50). Any overall statistically significant differences were further analyzed by dosage, cohort, and older siblings' STARBASE participation. These follow-up analyses are reported if statistically significant. Statistical significance means that there is less than a 1 in 20 probability that the difference occurred by chance. Conversely, this means that a statistically significant difference will likely emerge every 20 or so analyses, just by chance.

Given the large number of measures analyzed (over 80), we would anticipate the analyses to show a few statistically significant differences.

Results

STARBASE and comparison students performed very similarly on the school record-based outcome measures described above. Three statistically significant differences emerged from the analyses and are described below. Again, these differences could simply be due to chance, rather than a program impact, because of the large number of statistical tests conducted.

Junior high school weighted grade average in science

In junior high school, STARBASE students had a statistically significantly ($p<.05$) higher weighted grade average in science (2.93) than comparison students (2.71) based on a four-point scale (Figure A23). Follow-up analyses indicated that the difference occurred among the high dosage STARBASE students, who outperformed their comparison matches (3.06 vs. 2.75) ($p<.05$) (Figure 11, A36). Other science-related indicators, such as the number of science courses completed, number of science honors courses completed, math and science combined weighted grade average, and the combined percentage of math, science, and technology courses passed, did not yield any statistically significant differences. Additionally, no science-specific outcome measured in the high school or survey analyses resulted in any statistically significant differences, suggesting that the junior high school weighted grade average in science was an isolated occurrence of significance.

11. Junior high school weighted grade average in science

Subgroup	N[a]	STARBASE	Comparison	Significance
All	161	2.93	2.71	*
High dosage	129	3.06	2.75	*
Low dosage	32	2.43	2.55	ns

* *p<.05*

ns not statistically significant

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 161 STARBASE students were compared to 161 comparison students).*

10th grade algebra 2 completion

A second statistically significant difference emerged from the indicators measured in the 10th grade cumulative analysis. More STARBASE (46%) than comparison students (35%)

successfully completed algebra 2 or a higher level math course during their first two years of high school ($p<.01$) (Figure A27). This is an important finding considering that when these students were in high school, algebra 2 was often not taken until 11th grade, suggesting a rigorous math schedule for nearly half of STARBASE students. Further analyses examining dosage and cohort indicated statistically significant differences in the high dosage and 11th grade cohort subgroups ($p<.01$) (Figure 12).

12. Successfully completed algebra 2 or higher level math in 10th grade

Subgroup	N[a]	STARBASE	Comparison	Significance
All	193	46%	35%	**
High dosage	157	47%	34%	**
Low dosage	35	46%	37%	ns
11th grade cohort	127	49%	34%	**
12th grade cohort	66	41%	36%	ns

** *p<.01*

ns not statistically significant

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 193 STARBASE students were compared to 193 comparison students).*

The STARBASE advantage was not seen in 12th grade, when almost all students in both groups had completed algebra 2 or a higher level math course (91% STARBASE and 88% comparison) (Figure A30). Additionally, statistically significant differences did not emerge in other math-related indicators such as highest level math course completed, number of math courses completed, number of math honors courses completed, math weighted grade average, or the combined percentage of math, science, and technology courses passed. Furthermore, no math-specific outcome measured in junior high school, other senior high school (i.e., 9th or 12th grade), or survey analyses resulted in any statistically significant differences, suggesting that the algebra 2 completion difference was an isolated finding of significance.

Senior high school attendance

During the 2007-08 school year, STARBASE students were absent an average of 8.3 days while comparison students were absent 9.5 days. This difference was statistically significant ($p<.05$), but further analyses that examined differences by dosage and cohort were not. Additionally, the percentage of students who were chronically absent did not significantly differ between STARBASE and comparison students (Figure A33).

Dosage

Similar to survey results, examination of student record-based measures over time suggested a very modest pattern of STARBASE students with a high dosage performing slightly better on more measures than those with a low dosage. This pattern was seen on the indicators measured in junior high school and 9th grade, but did not continue in 10th grade or after. Specifically in these early grades, high dosage students took slightly more honors courses overall, as well as in math and science particularly, than low dosage students. Also, high dosage students had slightly better weighted grade averages and passed a higher percentage of courses overall, and in math and science, compared to low dosage students (Figures A36-A39). While these differences were not statistically significant, and very small (usually only a few tenths or hundredths of a point separate the groups), the pattern, coupled with survey results, suggests that a higher dosage of STARBASE may be influencing students' course choices and academic performance to a slight extent. Further analyses indicated that these dosage differences were *not* likely due to demographic or academic differences between the high and low dosage subgroups (see "technical details of study methods" in the Appendix). Additionally, it may suggest that STARBASE has shorter term effects since the pattern does not continue past 9th grade. School record-based outcome measures were also examined by cohort over time, but no patterns emerged.

Issues to consider

Past research has shown that even with programs that have a particular emphasis on academic achievement, it is often difficult to observe any measurable differences in academic outcomes (Wimer, 2006). Previous short-term studies of STARBASE Minnesota (Van Wie, 2006) and STARBASE Atlantis (Lee-Pearce, et al., 1998) showed initial program effects, including increased understanding of science and math concepts. However, this study differs from previous STARBASE studies as it focused on students who participated in STARBASE four to eight years ago. The number of years since program participation and the limited amount of program exposure led us to anticipate a low program impact, so it is not surprising that school record-based data yielded few statistically significant differences. Alternatively, the survey data suggest limited program impact over time, which has the potential to be strengthened with further STARBASE exposure or reinforcement of content. The issues to consider below focus on ways to strengthen or sustain short-term program effects over time. Program staff and stakeholders may want to consider these issues in future program planning and development.

Dosage

There are some indications that a higher STARBASE dosage (4th and 6th grades vs. 4th grade only) may result in a greater likelihood of a STARBASE impact, even though a program impact wasn't detected on many of the study indicators. Results showed that higher dosage was linked with stronger outcome results on some measures, especially survey items that measure perceptions of STEM-related learning and reports of STEM-related activities. Additionally, the pattern was seen in some academic performance measures, and while very modest, it is fairly consistent throughout junior high school and 9th grade.

This may be explained by the idea that more exposure produces more influence or impact. If correct, this would suggest that providing more dosages or larger dosages may lead to greater program impacts. It might also suggest that strengthening follow-up by teachers in the classroom could improve impact, as further described below. Alternatively, it may suggest that STARBASE effects are short-term, fading over time. That is, it may be more a question of when the dosage occurred than the dosage amount. Hence, the 6th grade dosage may be more likely to influence students in junior high school than the 4th grade dosage, simply because the 6th grade dosage occurred more recently. This explanation suggests the need for periodic dosages to maintain an impact over time. Since students who attended STARBASE in 6th grade only were not included in the study, it is difficult to ascertain which explanation has more merit. However, survey results suggest that STARBASE increased high school students' interest in STEM contradicting the idea that the program has only short-term effects. Therefore, results suggest that, at a minimum, the program would *not* want to reduce the dosage or level of program exposure, and might consider ways to increase it.

Integration with classroom curriculum

STARBASE has taken key steps to align and integrate its programming into the classroom. The program regularly monitors school curriculum and teachers are given a manual that contains a curriculum overview, state and national standards alignment, lesson plans with clear objectives, and other resources. Continuing to build on and review these efforts should help ensure congruence with what is being covered in the classrooms at the schools served. STARBASE may also want to consider other ways to work with teachers, schools, or other STEM organizations to reinforce program content through such things as teacher training or additional follow-up materials for teachers and students as a way to enhance program effects. Perhaps program effects could be enhanced by working even more closely with participating teachers and schools. Maximizing the congruence and integration of the two curricula and providing other tools or STEM experiences that build on students' initial exposure may help to strengthen the impact of the program experience

on students. Teachers are also more likely to use the follow-up STARBASE lessons and materials if they see them as enhancing or reinforcing what they are already trying to accomplish in their classrooms.

Longer term effects of interests stimulated

Survey results of former STARBASE students in high school suggest that STARBASE increased their interest in STEM and the military. Creating or increasing student interest in STEM or the military may have longer term effects, even though such effects are not seen clearly in the shorter term. That is, interests stimulated by the program may be manifested later in fields of study in college or career choices (Tai, et al., 2006).

References

Lee-Pearce, M.L., Plowman, T.S., & Touchstone, D. (1998). Starbase-Atlantis, a school without walls: A comparative study of an innovative science program for at-risk urban elementary students. *Journal of Education for Students Placed at Risk, 3(3),* 223-235.

Tai, R.H., Liu, C.Q., Maltese, A.V., & Fan, X. (2006, May). Planning early for careers in science. *Science*, *312,* 1143-1144.

Van Wie, K. (2006). *Midrange efficacy report: What do STARBASE participants retain after 3 months?* STARBASE Minnesota internal document, Saint Paul, MN.

Van Wie, K. (2001). *Longitudinal study: Survey of former STARBASE students.* STARBASE Minnesota internal document, Saint Paul, MN.

Wimer, C. (2006, May). Learning from small-scale experimental evaluations of after school programs. *Harvard Family Research Project.* Retrieved June 10, 2009, from http://www.hfrp.org/publications-resources/browse-our-publications/learning-from-small-scale-experimental-evaluations-of-after-school-programs

Appendix

Program logic model

Technical details of study methods

STARBASE survey

Survey results

School records results

Program logic model

STARBASE MINNESOTA

The Need, The Solution, The Expected Outcomes — February 13, 2001

Mission of STARBASE Minnesota: *The mission of STARBASE Minnesota is to inspire youth and promote their academic and lifelong success through authentic and exciting learning experiences in science, mathematics, and technology.*

CIRCUMSTANCES — *The Need*

- Inner city students from Minneapolis and St. Paul on average perform below their Twin Cities metro area peers and the statewide average in science and math.
- On average, inner city children of color perform below their inner city white counterparts in science and math.
- Minneapolis and St. Paul inner city students receive science instruction as little as 5 times a month.
- Students lack foundational skills in science, mathematics and technology and begin losing interest in science and math at an early age.
- Students lack hands-on, authentic applications for learning science and math
- ELL (English Language Learners) —over one third inner city students, need hands-on opportunities that break through language barriers in which to be successful
- Students' life experiences — and vision of themselves —are often limited to their own schools and neighborhoods. They lack awareness of careers.
- Many soci-economically disadvantaged students lack interaction with successful adult role models.
- Students lack higher level coursework in science, math, and technology to pursue and gain future access to high-tech, high-skilled and high paying jobs.
- Students need to learn and practice work readiness skills: problem solving, team work, communication skills, research, analysis, decision making
- Teachers lack expertise and confidence in teaching science.
- Schools lack adequate time and resources dedicated to science and technology.
- Schools need support in implementing the MN Graduation Standards
- Schools can't do it alone. They need support and involvement of the community.

ACTIONS — The Solution

STARBASE Minnesota provides:

- Intensive, hands-on, inquiry based, quality instruction in science, math, and technology for students grades 4-8
- Proven success in increasing students' knowledge, skills and motivation in science, mathematics and technology, including students with English as a second language.
- Real-world, authentic applications to learning science, math, and technology through unique aerospace resources that schools cannot replicate.
- Certified, professional instructors with expertise in science, mathematics and technology that utilize effective approaches to teaching and learning.
- Interaction with adult role models who use science, math and technology in the workplace; exposure to careers
- Rigorous curriculum that is in alignment with national and state standards in science, mathematics and technology
- Expertise and resources to classroom teachers through observation, participation and extension activities.

STARBASE — INITIAL OUTCOMES

- Students improve their knowledge and application of skills in science, mathematics, and technology
- Students broaden their view of themselves and what careers are possible for their futures
- Students demonstrate work readiness skills: problem solving, team work, communication skills, data analysis, decision making
- Students experience fun learning; satisfaction.
- Students demonstrate positive attitudes towards science, mathematics, and technology; believe in their abilities
- Students express interest in pursuing more science, math and technology after STARBASE.
- Teachers support their students' learning at STARBASE.
- Teachers gain knowledge, awareness, strategies, skills
- Teacher satisfaction with STARBASE; want to return
- STARBASE helps schools/ teachers meet academic/other goals and standards
- Teachers indicate plans to utilize post lessons, further work
- Teachers have positive regard for Guard

INTERMEDIATE OUTCOMES

- Students make connections / apply what they learned at STARBASE to their learning at school.
- Students maintain interest and motivation for learning science, math, technology; related careers.
- Students continue to develop knowledge and skills in science, mathematics and technology
- Teachers use the information and techniques gained at STARBASE in classrooms and extend learning.
- Teachers support student interest in science, math, and technology

LONG TERM OUTCOMES — VISION

- Students maintain interest and motivation for learning science, mathematics, technology in high school
- Students choose to take science, mathematics and technology courses in high school and necessary coursework that improves access to high-tech jobs
- Students demonstrate academic success in science, mathematics and technology and completion of high school.
- Teachers knowledge, skills and practices in teaching science, math, and technology are enhanced.
- Skilled and educated workforce; successful and productive citizens.

Technical details of study methods

Matching procedure

The study utilized a matched-comparison design; students who participated in STARBASE were compared to demographically and academically similar students who did not participate in STARBASE. The matching procedure is described below.

Identify potential STARBASE group students

Utilizing Saint Paul Public Schools (SPPS) and STARBASE program records, Wilder Research identified students who met the following criteria: 1) enrolled in SPPS during the 2008-09 school year as a 10th, 11th, or 12th grade student, 2) enrolled in SPPS in 3rd and 4th grades, and 3) attended STARBASE as a 4th grade student (i.e., in 2000-01 for the 12th grade cohort, 2001-02 for the 11th grade cohort, and 2002-03 for the 10th grade cohort). These criteria yielded an initial sample size of 501 students (i.e., 256 in 10th grade, 153 in 11th grade, and 92 in 12th grade).

Identify potential comparison group students

Based on SPPS records, Wilder Research identified students who met the following criteria: 1) enrolled in SPPS during the 2008-09 school year as a 10th, 11th, or 12th grade student, 2) enrolled in SPPS in 3rd and 4th grades, and 3) did not attend an elementary school that participated in STARBASE or had a special emphasis on math, science, or technology (e.g., Crossroads Science) in 4th grade (or 6th grade for the 12th grade cohort as 6th grade school data were available only for this cohort). Students who met these criteria were then screened using STARBASE program records to ensure they hadn't participated in the program. These criteria yielded a sample size of 3,943 students from which to identify matches.

Match STARBASE and comparison students

Wilder Research identified a list of characteristics (variables) on which students were matched. Student pairs were required to match on the following variables: grade level in 2008-09, high school attended in 2008-09, 3rd grade Minnesota Comprehensive Assessment (MCA) math level score, and 3rd grade MCA reading level score. Additionally, student pairs were required to match on one or more of the following five variables: economic status (i.e., free or reduced-price lunch eligibility in 4th grade), English Language Learner status (i.e., limited English proficiency description in 4th grade), special education status (i.e., individualized education plan in 4th grade), sex, and race/ethnicity (i.e., White not Hispanic, Asian/Pacific Islander, or Black/Native

American/Hispanic). This matching procedure produced 442 student pairs, including 69 percent that matched on all nine characteristics, 15 percent that matched on eight characteristics, 8 percent that matched on seven characteristics, 6 percent that matched six characteristics, and 2 percent that matched on five characteristics. Overall, a match was found for 88 percent of STARBASE students meeting the study criteria. Students without a match were excluded from the study.

Survey

Survey administration

A total of 762 students (381 STARBASE and 381 comparison) across all three cohorts at four SPPS senior high schools were identified to participate in the survey. Harding, Johnson, and Central senior high school students were eligible because those schools had the largest numbers of STARBASE study participants enrolled, as well as Arlington Senior High School students due to the school's science, technology, engineering, and math focus. Also in order to be eligible for the survey, student pairs had to match on four essential characteristics (grade level in 2008-09, high school attended in 2008-09, 3rd grade MCA math level score, and 3rd grade MCA reading level score) plus an additional demographic characteristic (economic status, English Language Learner status, special education status, sex, or race/ethnicity).

Administrators at some high schools identified survey eligible students who were no longer enrolled, dropping the sample by 40 students, and another six students were dropped due to missing program information. Of those students still remaining eligible, 507 completed the survey during an advisory period in April 2009 for a response rate of 71 percent. Of those completed surveys, 170 student pairs (67%) remained intact, and these 340 surveys were used in the survey analysis. Most student pairs (70%) matched on all nine characteristics, 12 percent had eight characteristics in common, 10 percent matched on seven characteristics, 5 percent matched on six characteristics, and just 3 percent matched on five characteristics.

Analysis of characteristics of those included and not included in the survey

The demographic and academic characteristics of students whose survey responses were included in the data analysis (170 STARBASE and 170 comparison students) were compared to the characteristics of study students who either did not take the survey or whose survey responses were not included in the analysis (331 STARBASE and 331 comparison students). Specifically, differences in grade level in 2008-09, 3rd grade MCA math level score, 3rd grade MCA reading level score, economic status, English Language Learner status, special education status, sex, and race/ethnicity were examined to

determine if the characteristics of students whose survey responses were used in the analysis differed in any significant way from students who were not included in the survey analysis. There were few statistically significant differences, but in both STARBASE and comparison groups, slightly more Asian students and fewer White and Black/Native American/Hispanic students were included in the survey analysis compared to those students who were not included ($p<.01$). A related statistically significant finding emerged among the English Language Learner students in the comparison group ($p<.01$); slightly more English Language Learner students were included in the survey analysis (Figure A1).

A1. Survey analysis inclusion by characteristics

		STARBASE			Comparison	
Subgroup	N	Included in survey analysis	Not included in survey analysis	N	Included in survey analysis	Not included in survey analysis
White not Hispanic	85	15%	18%	84	13%	19%
Asian or Pacific Islander	275	65%	50%	277	67%	50%
Hispanic/Black/ Native American	141	21%	32%	140	21%	32%
English Language Learner	229	52%	43%	222	52%	40%
Not an English Language Learner	272	48%	57%	279	48%	60%

Note. *There was a statistically significant difference in race/ethnicity between those included and those not included in the survey analysis in both the STARBASE and comparison groups (p<.01). There was also a statistically significant difference in English Language Learner status between those included and those not included in the survey analysis in the comparison group (p<.01).*

Profile of matched pairs

As indicated above, student pairs were required to match on four academic and demographic characteristics (i.e., grade level in 2008-09, high school attended in 2008-09, 3rd grade MCA math level score, and 3rd grade MCA reading level score). Additionally, student pairs were required to match on one or more of five additional demographic characteristics and most student pairs matched on all or most of these characteristics. Further analyses indicated that STARBASE and comparison groups are very similar with regard to the five demographic matching characteristics as indicated in Figure A2 below. Students' 3rd grade MCA math and reading scores and grade level in 2008-09 were also included to show the frequency distributions for these characteristics.

A2. Profile of matched pairs included in survey data analysis

Characteristic		STARBASE N=170	Comparison N=170
Free or reduced-price lunch[a]	Eligible	82%	87%
	Ineligible	18%	13%
English Language Learner[a]	Yes	52%	52%
	No	48%	48%
Special education[a]	Yes	10%	7%
	No	90%	94%
Sex[a]	Male	49%	49%
	Female	51%	51%
Race/ethnicity[a]	White not Hispanic	15%	13%
	Asian or Pacific Islander	65%	67%
	Black or Native American or Hispanic	21%	21%
MCA math level score[b, c]	Significantly below grade level/ Not meeting standards	12%	12%
	Slightly below grade level/ Partially meeting standards	45%	45%
	Successfully on grade level/ Meeting standards	29%	29%
	Above grade level/ Exceeding standards	13%	13%
	Well above grade level	1%	1%
MCA reading level score[b, d]	Significantly below grade level Not or partially meeting standards	55%	55%
	Slightly below to successfully on grade level/ Meeting or exceeding standards	35%	35%
	Above to well above grade level	10%	10%
Grade level in 2008-09[b]	10th	51%	51%
	11th	35%	35%
	12th	14%	14%

[a] *Characteristic as of 4th grade.*

[b] *Student pairs were required to match on3rd grade MCA math level score, 3rd grade MCA reading level score, and grade level in 2008-09, so there is no difference between STARBASE and comparison groups. It's included only to show the frequency distribution of these characteristics.*

[c] *The 11th and 12th grade cohorts' 3rd grade MCA math results were categorized into four levels while the 10th grade cohorts' 3rd grade MCA math results had five levels due to scoring changes between 2001 and 2002. The "well above grade level" category only includes students from the 10th grade cohort.*

[d] *The 11th and 12th grade cohorts' 3rd grade MCA reading results were categorized into four levels while the 10th grade cohorts' 3rd grade MCA reading results had five levels due to scoring changes between 2001 and 2002. For study purposes, the 11th and 12th grade cohorts' level scores were collapsed into two categories and the 10th grade cohorts' level scores were collapsed into three categories based on score distribution. The "above to well above grade level" category only includes students from the 10th grade cohort.*

School records

Saint Paul Public Schools record data were used to examine student outcome measures. Wilder Research analyzed outcome measures at four points in time including 8th grade cumulatively, 9th grade, 10th grade cumulatively, and 12th grade cumulatively (Figure A3). As indicated above, students fall into one of three cohorts (i.e., 10th, 11th, or 12th grade) based on their grade level in 2008-09. Researchers utilized the records of as many cohorts as possible for each set of outcomes measured. For example, when measuring outcomes from students' 9th grade year, the records of cohorts 10, 11, and 12 were used, but when analyzing outcomes based on students' senior high school career (i.e., 9th-12th grade), only the records of cohort 12 were used. A table summarizing the school record data analysis plan is shown in Figure A3 below.

A3. School record data analysis plan

Grade level outcomes measured in	Grade levels included	Cohort
8th grade cumulative	7, 8	10
9th grade	9	10, 11, 12
10th grade cumulative	9, 10	11, 12[a]
12th grade cumulative	9, 10, 11, 12[b]	12

[a] *The 10th grade cohort was not included because data were available for the first semester only.*

[b] *Data were available for the first semester only.*

Profile of matched pairs

Of the 442 matched student pairs in the study sample, 430 matched student pairs (97%) had available record data given the analysis plan above. Specific sample sizes vary by grade level and outcome measure (see Figures A23-A50).

Analyses were conducted to determine the demographic characteristics of the matched student pairs included in the school records data portion of the study. These analyses showed that STARBASE and comparison students had very similar profiles on the five demographic characteristics utilized in the matching process. See Figure A4 below for details. Students' 3rd grade MCA math and reading scores and grade level in 2008-09 were also included to show the frequency distributions for these characteristics.

A4. Profile of matched pairs included in school record data analysis

Characteristic		STARBASE N=430	Comparison N=430
Free or reduced-price lunch[a]	Eligible	81%	83%
	Ineligible	19%	17%
English Language Learner[a]	Yes	46%	45%
	No	54%	55%
Special education[a]	Yes	12%	8%
	No	88%	92%
Sex[a]	Male	50%	48%
	Female	51%	52%
Race/ethnicity[a]	White not Hispanic	16%	16%
	Asian or Pacific Islander	56%	57%
	Black or Native American or Hispanic	28%	27%
MCA math level score[b, c]	Significantly below grade level/ Not meeting standards	17%	17%
	Slightly below grade level/ Partially meeting standards	44%	44%
	Successfully on grade level/ Meeting standards	22%	22%
	Above grade level/ Exceeding standards	16%	16%
	Well above grade level	1%	1%
MCA reading level score[b, d]	Significantly below grade level/ Not or partially meeting standards	54%	54%
	Slightly below to successfully on grade level/ Meeting or exceeding standards	36%	36%
	Above to well above grade level	11%	11%
Grade level in 2008-09[b]	10th	54%	54%
	11th	31%	31%
	12th	16%	16%

[a] *Characteristic as of 4th grade.*

[b] *Student pairs were required to match on3rd grade MCA math level score, 3rd grade MCA reading level score, and grade level in 2008-09, so there is no difference between STARBASE and comparison groups. It's included only to show the frequency distribution of these characteristics.*

[c] *The 11th and 12th grade cohorts' 3rd grade MCA math results were categorized into four levels while the 10th grade cohorts' 3rd grade MCA math results had five levels due to scoring changes between 2001 and 2002. The "well above grade level" category only includes students from the 10th grade cohort.*

[d] *The 11th and 12th grade cohorts' 3rd grade MCA reading results were categorized into four levels while the 10th grade cohorts' 3rd grade MCA reading results had five levels due to scoring changes between 2001 and 2002. For study purposes, the 11th and 12th grade cohorts' level scores were collapsed into two categories and the 10th grade cohorts' level scores were collapsed into three categories based on score distribution. The "above to well above grade level" category only includes students from the 10th grade cohort.*

Construction of study indicators

The following section describes a number of the indicators used in the study and how each was constructed. For the indicators that utilized school record data, we relied heavily on the SPPS 7- digit course number system (e.g., S4-0510-1) that was introduced in 2004. Each digit(s) represents a department (e.g., science, math), grade level group (e.g., junior or senior high school), learning level (e.g., general, honors, advanced placement), subgroup (e.g., biology, chemistry), individual course number (e.g. microbiology), or term (1st semester). Courses taken outside of SPPS, such as post-secondary enrollment options (PSEO) classes, were not available for inclusion in the study.

STARBASE dosage

Two levels of STARBASE dosage were constructed, low and high. Students with a low dosage attended STARBASE in 4th grade, did not attend in 6th grade, and may or may not have attended in 8th grade. Students with a high dosage attended STARBASE in 4th and 6th grades, and may or may not have attended in 8th grade. Eighth grade participation was not considered in the construction of the dosage variable because the 8th grade summer program was not as academically rigorous as in 4th and 6th grades, and there were very few students in the sample who attended STARBASE in 8th grade. Most of the schools that STARBASE students attended in 4th grade participated in STARBASE again two years later when those students were in 6th grade, providing the opportunity for many students to have a high dosage level.

The demographic and academic characteristics of high dosage (84%) and low dosage (16%) students who were included in the survey analysis were compared. There were no statistically significant differences between the subgroups based on the following characteristics: grade level in 2008-09, 3rd grade MCA math level score, 3rd grade MCA reading level score, economic status, English Language Learner status, special education status, sex, and race/ethnicity.

Additionally, the demographic and academic characteristics of high dosage (81%) and low dosage (19%) students who were included in the school record analysis were compared. There was a statistically significant difference in race/ethnicity between dosage subgroups as more Asian/Pacific Islander students were included in the high dosage subgroup and more Black/Native American/Hispanic students were in the low dosage subgroup ($p<.001$). There were no statistically significant differences based on the following characteristics: grade level in 2008-09, 3rd grade MCA math level score, 3rd grade MCA reading level score, economic status, English Language Learner status, special education status, and sex.

Older siblings' participation in STARBASE

Students who took the survey were asked to indicate if they had an older brother or sister who participated in the STARBASE program. Just over one-third (36%) of STARBASE students and 2 percent of comparison students indicated that they had an older sibling that participated in the program. The subgroup, older siblings' participation in STARBASE, was constructed based on STARBASE participants who reported they had an older sibling who also participated in the program. Those who indicated either no or don't know were combined into the no category for purposes of data analysis.

Highest math passed

Modeled after Adelman's (1999) "HIGHMATH" (highest level of mathematics reached in high school) variable, this indicator has six categories: 1) general math, 2) algebra 1, 3) geometry, 4) algebra 2, 5) pre-calculus, trigonometry, or statistics, and 6) calculus. It was obvious for most course titles where the course should be placed (e.g., Algebra 1) and the SPPS Program Manager for Secondary Math confirmed the classification of less obvious course titles (e.g., High School Math) (Marty Gaslin, personal communication, April 14, 2009). Additionally, equivalent categories were determined for Integrated Math courses which utilize an embedded spiraling approach that combines a number of math subject areas (e.g., algebra and geometry) into one course. For example, Integrated Math 1 was classified as algebra 1 and Integrated Math 4 was classified as pre-calculus, trigonometry, or statistics (Marty Gaslin, personal communication, April 14, 2009).

Honors courses

For study purposes, honors courses include those classified as honors, advanced placement, international baccalaureate, or college in the schools.

Percentage of courses passed

Course letter grades A+ through D-, P, and CR were classified as passing. Course letter grades of N, NM, NP, I, and W were classified as not passing. The number of passed courses were added together and divided by the total number of courses (i.e., passed + not passed) to determine the percentage of courses passed. Course data were from the end of the term; so, in theory courses that students' legitimately dropped early in the term were excluded from the data set (Steven Schellenberg, SPPS, personal communication, April 8, 2009). Because credits earned and on-track-to-graduate information were not available, this indicator was constructed to give insight into students' overall academic progress.

STEM momentum

This indicator was modeled after Adelman's (2006) "SCIMOM" (high school momentum in science and mathematics) variable. It has four categories: Sufficient) student reached a level of math beyond algebra 2 and successfully completed three or more core lab science classes (i.e., biology, chemistry, or physics); Modest) student reached a level of math equivalent to algebra 2 and successfully completed three or more core lab science classes *or* student reached a level of math beyond algebra 2 and successfully completed two core lab science classes; Minimal) student reached a level of math equivalent to algebra 2 and successfully completed two core lab science classes; and Weak) student fell short of the above criteria.

Weighted grade average

Each individual course letter grade was assigned a numerical value (e.g., A=4.0, C=2.0), and classes with a learning level of honors, advanced placement, international baccalaureate, or college in the schools were weighted by multiplying by 1.25 (e.g., honors class A=5.0) based on SPPS policy (Thompson, 2004). These numerical values were added together and divided by the number of courses to determine the weighted grade average. We were not able to calculate weighted grade point average since credit information was unavailable.

Data analysis

When analyzing results, researchers used a directional or one-tailed hypothesis because of the assumption that STARBASE students would perform better than the comparison group on outcome measures (Lee-Pearce, et al., 1998). This means that statistically significant differences were only reported if they supported the directional hypothesis. If a statistically significant difference emerged in which the comparison group outperformed the STARBASE group, it was not reported.

If a non-directional or two-tailed hypothesis were used (i.e., one that does not assume one group will perform better than the other), the statistically significant results would have changed as follows. For the survey results, there would not have been a statistically significant difference in technology interest level by group or how much STARBASE helped students understand science, math, technology, or engineering by dosage level. For the school record results, there would not have been a statistically significant difference in the junior high school weighted grade average in science. Additionally, it would have been reported that comparison students took significantly more technology courses than their STARBASE counterparts in junior high school ($p<.05$) (Figure A23).

It should also be noted that SPPS data indicated that seven students took both 8th grade courses and 9th grade courses during their 9th grade school year. For these cases, researchers coded all courses taken during students' 9th grade school year as 9th grade courses.

Testing for statistical significance

In this matched-comparison study, we used a number of statistical tests to determine significance based on the type of data measured. For nominal and ordinal data, chi-square tests were used to test for association between variables. The *McNemar* test is a non-parametric test used to assess the significance of difference between dependent samples (e.g., matched pairs) when dichotomous nominal variables are analyzed. This test was performed to determine significance of differences on study measures such as participation in STEM-related or military activities and whether or not a student had completed algebra 2. The *McNemar-Bowker* test was used for non-dichotomous nominal and ordinal data such as students' STEM interest level or highest math course passed. *Pearson's chi square* test was used to determine the similarity of two groups based on demographic and academic characteristics. Finally, scale data (e.g., course count, grade average) were tested for significance using *paired sample t-tests*, a statistical technique used to compare the means (averages) of two related groups (e.g., matched pairs).

References

Adelman, C. (1999). *Answers in the Tool Box: Academic Intensity, Attendance Patterns, and Bachelor's Degree Attainment.* Washington, DC: U.S. Department of Education.

Adelman, C. (2006). *The Toolbox Revisited: Paths to Degree Completion From High School Through College.* Washington, DC: U.S. Department of Education.

Lee-Pearce, M.L., Plowman, T.S., & Touchstone, D. (1998). Starbase-Atlantis, a school without walls: A comparative study of an innovative science program for at-risk urban elementary students. *Journal of Education for Students Placed at Risk, 3(3),* 223-235.

Thompson, M. (2004, October 6). *Grade point system and new honors course weighting formula for students in the class of 2008 and beyond*. Saint Paul Public Schools memo, Saint Paul, MN.

STARBASE survey

Advisory: _____

Name: _____ ID number: _____ Grade: _____

High school: _____ High school number: _____ Group: _____

Please take a few moments to complete this survey. The information you provide will help us learn more about students' interests in science, math, technology and engineering as well as the impact of the STARBASE program. Your answers will be kept confidential. Your name will not be attached to the answers you give in the report of survey results. Please ***check only one box per question and complete both sides of the survey.***

1. In elementary school, did you participate in STARBASE, a 5-day science, math, technology, and engineering program? (STARBASE is at the MN Air Guard military base. Students get "call signs" and do activities such as build rockets to see how science, math, technology, and engineering are used in aerospace).

   ❒[1] Yes ❒[2] No

If Yes, continue with question 2. If No, SKIP ahead to question 9 on the back.

2. What do you remember most about participating in STARBASE? _____

   _____

3. Did STARBASE increase your <u>interest</u> in…

	A lot	Some	A little	None
a. science?	❒[4]	❒[3]	❒[2]	❒[1]
b. math?	❒[4]	❒[3]	❒[2]	❒[1]
c. technology? (e.g., computers)	❒[4]	❒[3]	❒[2]	❒[1]
d. engineering?	❒[4]	❒[3]	❒[2]	❒[1]

4. Did you get involved in science, math, technology or engineering activities or programs because of STARBASE?

   ❒[1] Yes ❒[2] No

   If Yes, what activities/programs were these? _____

   _____

5. Did STARBASE help you <u>understand</u> science, math, technology or engineering better?

   ❒[4] A lot ❒[3] Some ❒[2] A little ❒[1] None

6. Did STARBASE help you learn about careers related to science, math, technology or engineering?

   ❒[4] A lot ❒[3] Some ❒[2] A little ❒[1] None

7. Was STARBASE a valuable learning experience?

   ❒[1] Yes ❒[2] No ❒[8] Don't know

8. Do you think your participation in STARBASE continues to impact you today?

   ❒[1] Yes ❒[2] No ❒[8] Don't know

   If Yes, how so? _____

   _____

OVER

9. Do you currently participate in any activities, clubs, or programs related to science, math, technology or engineering?
   ❒1 Yes ❒2 No
   If Yes, which one(s)? _____
   _____

10. Do you currently participate in any activities, clubs, or programs related to the military (e.g., JROTC)?
   ❒1 Yes ❒2 No
   If Yes, which one(s)? _____
   _____

11. Have any past experiences or activities (besides STARBASE) increased your interest in science, math, technology or engineering?
   ❒1 Yes ❒2 No
   If Yes, what activities/experiences were these? _____
   _____

12. How much <u>interest</u> do you have in…

	A lot	Some	A little	None
a. science?	❒4	❒3	❒2	❒1
b. math?	❒4	❒3	❒2	❒1
c. technology? (e.g., computers)	❒4	❒3	❒2	❒1
d. engineering?	❒4	❒3	❒2	❒1

13. What is your favorite <u>core</u> subject in school? (Check one)
   ❒1 English/Language Arts ❒3 Science
   ❒2 Math ❒4 Social Studies

14. Do you plan on taking more science, math, computer or engineering classes in high school?
   ❒1 Yes, only what's required ❒3 No
   ❒2 Yes, more than what's required ❒8 Don't know

15. How much interest do you have in joining the military?
   ❒4 A lot ❒3 Some ❒2 A little ❒1 None ❒8 Don't know

16. Do you plan on going to college (2 year or 4 year)?
   ❒1 Yes ❒2 No ❒8 Don't know

17. Do you plan on getting a job related to science, math, technology or engineering?
   ❒1 Yes ❒2 No ❒8 Don't know

18. Do you have an older brother or sister who participated in the STARBASE program?
   ❒1 Yes ❒2 No ❒8 Don't know

If Yes, continue with question 19. If No, you have completed the survey.

19. Did this older brother or sister who participated in STARBASE major in science, math, technology or engineering in college, or do they now have a job in one of these areas?
   ❒1 Yes ❒2 No ❒8 Don't know

Thank you!

A5. What students remember most about participating in STARBASE

Response theme[a] N=153	Percentage[b]
Building and launching rockets or gliders	43%
Learning about rockets or airplanes	24%
Seeing the airplanes and helicopters in-person	23%
Computer flight simulation	22%
Other activities and experiments	13%
Learning about science and space	9%
Call names/signs	8%

[a] *Response themes developed by Wilder Research based on students' responses.*

[b] *Students' responses could be placed in multiple themes, so percentages do not sum to 100 percent.*

Note. *Other response themes include the following: having fun, making airplanes, building things, making and flying kites, watching movies, working with computers, the teachers, and don't remember (2-7 responses each).*

A6. How much STARBASE increased students' interest in math, science, technology, and engineering

Subject N=155	A lot	Some	A little	None
Technology	41%	36%	14%	10%
Engineering	28%	39%	20%	12%
Science	21%	48%	20%	12%
Math	16%	39%	27%	18%

A7. How participation in STARBASE continues to impact students today

Response theme[a] N=155	Percentage[b]
Knowledge and experience gained is used now	8%
Learned about science, math, technology, or engineering	6%
Learned about or want to pursue a career related to science, math, technology, or engineering	5%
Learned about aerospace (or STARBASE specific component)	4%
Realization of interest in or want to learn more about science, math, technology, or engineering	3%

[a] *Response themes developed by Wilder Research based on students' responses.*

[b] *Students' responses could be placed in multiple themes. Percentages based on total STARBASE group (N=155).*

Notes. *1) Only responses from students who indicated that STARBASE continues to impact them today (26%) were included.*

2) Other response themes include the following: learned something else and joined JROTC (2-3 responses each).

A8. Type of past experience or activity (besides STARBASE) that increased students' interest in science, math, technology, or engineering

	STARBASE N=52		Comparison N=50	
Response theme[a]	Number	Percentage[b]	Number	Percentage[b]
STEM-related class or lab at school	15	29%	17	34%
Informal STEM learning	9	17%	6	12%
Aerospace camp	7	14%	-	-
Field trips or other activities	5	10%	7	14%
Science fair	2	4%	5	10%

[a] *Response themes developed by Wilder Research based on students' responses.*

[b] *Students' responses could be placed in multiple themes. Percentages based on the number of students who indicated that a past experience increased their interest in science, math, technology, or engineering (N=52, 50).*

Notes. *1) Only responses from students who indicated that a past experience increased their interest in science, math, technology, or engineering (34% STARBASE and 31% comparison) were included.*

2) Other response themes include the following: job, internship or job shadow, STEM camp, JROTC, 3M, Project Lead the Way, or other STEM clubs or programs.

A9. Students' favorite core subject

	STARBASE N=163	Comparison N=163
Math	34%	35%
Science	33%	26%
English/Language Arts	22%	26%
Social Studies	12%	13%

A10. Plans for taking more science, math, computer or engineering classes in high school

	STARBASE N=166	Comparison N=166
Yes, more than what's required	41%	44%
Yes, only what's required	42%	33%
No or don't know	18%	23%

A11. How much STARBASE increased students' interest in math, science, technology, and engineering by dosage

Subject	Dosage	N	A lot	Some	A little	None
Technology	High dosage	134	43%	37%	13%	8%
	Low dosage	21	29%	33%	14%	24%
Engineering	High dosage	134	28%	40%	20%	11%
	Low dosage	21	29%	33%	19%	19%
Science	High dosage	134	23%	46%	20%	10%
	Low dosage	21	5%	57%	19%	19%
Math	High dosage	134	16%	40%	26%	18%
	Low dosage	21	14%	38%	29%	19%

Note. *Includes STARBASE students only.*

A12. Students got involved in science, math, technology, or engineering activities or programs because of STARBASE by dosage

	N	Yes	No
STARBASE	155	18%	82%
High dosage	134	19%	81%
Low dosage	21	14%	86%

Note. *Includes STARBASE students only.*

A13. STARBASE was a valuable learning experience by dosage

	N	Yes	No	Don't know
STARBASE	155	82%	1%	17%
High dosage	134	81%	1%	17%
Low dosage	21	86%	-	14%

Note. *Includes STARBASE students only.*

A14. Participation in STARBASE continues to impact you today by dosage

	N	Yes	No	Don't know
STARBASE	155	26%	17%	57%
High dosage	134	28%	16%	57%
Low dosage	21	19%	24%	57%

Note. *Includes STARBASE students only.*

A15. How much interest students have in science, math, technology, and engineering by dosage

Subject		N	A lot	Some	A little	None
Technology	High dosage	143	48%	34%	11%	6%
	Low dosage	27	52%	22%	22%	4%
Science	High dosage	143	27%	49%	18%	6%
	Low dosage	27	26%	41%	30%	4%
Math	High dosage	143	26%	46%	18%	10%
	Low dosage	27	30%	33%	26%	11%
Engineering	High dosage	143	28%	32%	28%	13%
	Low dosage	27	26%	26%	33%	15%

Note. *Includes only STARBASE students.*

A16. Current participation rates in science, math, technology, or engineering-related programs by dosage

	N	Percentage participating in a program, club, or activity
STARBASE	168	12%
High dosage	142	14%
Low dosage	26	-

Note. *Includes only STARBASE students.*

A17. Current participation rates in military-related programs by dosage

	N	Percentage participating in a program, club, or activity
STARBASE	170	13%
High dosage	143	12%
Low dosage	27	19%

Note. *Includes only STARBASE students.*

A18. Past experience or activity (besides STARBASE) increased students' interest in science, math, technology, or engineering by dosage

	N	Percentage responding yes
STARBASE	170	34%
High dosage	143	34%
Low dosage	27	30%

Note. *Includes only STARBASE students.*

A19. Students' favorite core subject by dosage

	STARBASE N=167	High dosage N=140	Low dosage N=27
Math	34%	33%	41%
Science	32%	32%	30%
English/Language Arts	22%	22%	19%
Social Studies	13%	13%	11%

Note. *Includes only STARBASE students.*

A20. Plans for taking more science, math, computer or engineering classes in high school by dosage

	STARBASE N=169	High dosage N=140	Low dosage N=27
Yes, more than what's required	40%	41%	37%
Yes, only what's required	43%	42%	48%
No or don't know	17%	18%	15%

Note. *Includes only STARBASE students.*

A21. Plans for attending college by dosage

Going to college (2 or 4 year)?	N	Yes
STARBASE	170	95%
High dosage	143	96%
Low dosage	27	93%

Note. *Includes only STARBASE students.*

A22. Plans for pursuing a job related to science, math, technology, or engineering by dosage

	N	Yes
STARBASE	170	47%
High dosage	143	49%
Low dosage	27	37%

Note. *Includes only STARBASE students.*

School records results

A23. 8th grade cumulative (junior high school) outcome measures

Outcome measure	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count				
Math	161	2.19	2.14	.043
Science	161	2.05	2.04	.006
Technology	161	0.02	0.13	-.112
Math + Science + Technology	161	4.25	4.32	-.062
Math honors	161	0.25	0.25	-
Science honors	161	0.59	0.53	.062
Math + Science honors	161	0.84	0.78	.062
All honors	161	2.41	2.08	.329
Weighted grade average				
Math	159	2.48	2.47	.011
Science	161	2.93	2.71	.222*
Math + Science	161	2.71	2.60	.108
All	161	2.90	2.84	.060
Percentage of courses passed				
Math + Science + Technology	161	93%	92%	1.1%
All	161	93%	93%	0%

* *p<.05*

[a] Refers to the number in each group of the matched pairs comparison (e.g., 161 STARBASE students were compared to 161 comparison students).

Note. *Includes 7th and 8th grade SPPS records for the 10th grade cohort.*

A24. 8th grade cumulative (junior high school) highest math course passed

	N	General Math	Algebra 1	Geometry
STARBASE	154	61%	30%	9%
Comparison	154	57%	37%	6%

Note. *Includes 7th and 8th grade SPPS records for the 10th grade cohort.*

A25. 9th grade outcome measures

Outcome measure	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count				
Math	422	0.92	0.95	-.021
Science	422	0.93	0.92	.012
Technology	422	0.28	0.27	.014
Math + Science + Technology	422	2.14	2.14	.005
Lab sciences[b]	422	0.24	0.27	-.031
JROTC	422	0.13	0.13	.005
Math honors	422	0.28	0.27	.007
Science honors	422	0.32	0.31	.009
Technology honors	422	0	0	-
Math + Science honors	422	0.60	0.58	.017
All honors	422	1.42	1.41	.007
Weighted grade average				
Math	396	2.46	2.48	-.017
Science	407	2.48	2.44	.031
Technology	38	2.55	2.51	.041
Math + Science + Technology	415	2.45	2.45	.005
JROTC	13	3.53	3.22	.303
All	421	2.59	2.57	.019
Percentage of courses passed				
Math + Science + Technology	417	86%	87%	-.6%
All	424	89%	89%	0%
Percentage yes				
Successfully completed algebra 2 or higher math course	422	6%	8%	-1.4%

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 422 STARBASE students were compared to 422 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

Note. *Includes 9th grade SPPS records for the 10th, 11th, and 12th grade cohorts.*

A26. 9th grade highest math course passed

	N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]
STARBASE	343	2%	57%	34%	7%	1%
Comparison	343	3%	60%	28%	8%	1%

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th grade SPPS records for the 10th, 11th, and 12th grade cohorts.*

A27. 10th grade cumulative outcome measures

Outcome measure	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count				
Math	193	1.90	1.92	-.016
Science	193	1.92	1.91	.005
Technology	193	0.54	0.66	-.124
Math + Science + Technology	193	4.36	4.49	-.135
Lab sciences[b]	193	1.19	1.23	-.036
JROTC	193	0.22	0.20	.021
Math honors	193	0.72	0.63	.093
Science honors	193	0.75	0.68	.067
Technology honors	193	0	0	-
Math + Science honors	193	1.47	1.31	.161
All honors	193	3.38	3.15	.228
Weighted grade average				
Math	189	2.41	2.44	-.026
Science	190	2.59	2.50	.090
Technology	46	2.80	2.80	-.004
Math + Science + Technology	192	2.52	2.49	.035
JROTC[c]	-	-	-	-
All	193	2.69	2.62	.069
Percentage of courses passed				
Math + Science + Technology	192	88%	88%	.4%
All	193	91%	90%	1.1%
Percentage yes				
Successfully completed biology, chemistry, and physics	193	0%	0%	-
Successfully completed algebra 2 or higher math course[d]	193	46%	35%	11.4%**

** *p<.01*

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 193 STARBASE students were compared to 193 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

[d] *Wilder Research checked for differential effects by economic status, English Language Learner status, sex, and race/ethnicity. The following subgroups were statistically significant: males (p<.01), English Language Learners (p<.05), and free or reduced-price lunch eligible (p<.05). A substantive difference was found in the free or reduced-price lunch ineligible subgroup.*

Note. *Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

A28. 10th grade cumulative highest math course passed

	N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]	Calculus
STARBASE	182	1%	12%	39%	39%	9%	1%
Comparison	182	2%	13%	50%	28%	8%	1%

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

A29. 10th grade cumulative STEM momentum

	N	Sufficient	Modest	Minimal	Weak
STARBASE	193	1%	8%	12%	80%
Comparison	193	-	6%	16%	78%

Notes. *1) Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

2) STEM momentum categories include the following: Sufficient: student reached a level of math beyond algebra 2 and successfully completed three or more core lab science classes (i.e., biology, chemistry, or physics), Modest: student reached a level of math equivalent to algebra 2 and successfully completed three or more core lab science classes or student reached a level of math beyond algebra 2 and successfully completed two core lab science classes, Minimal: student reached a level of math equivalent to algebra 2 and successfully completed two core lab science classes, and Weak: student fell short of the above criteria.

A30. 12th grade cumulative (senior high school) outcome measures

Outcome measure	N[a]	Mean STARBASE	Mean Comparison	Difference & significance[d]
Course count				
Math	64	3.75	3.78	-.031
Science	64	3.80	3.70	.094
Technology	64	1.17	1.22	-.047
Math + Science + Technology	64	8.72	8.70	.016
Lab sciences[b]	64	2.83	2.86	-.031
JROTC	64	0.33	0.34	-.016
Math honors	64	1.67	1.77	-.094
Science honors	64	1.52	1.42	.094
Technology honors	64	0.05	0.06	-.016
Math + Science + Technology honors	64	3.23	3.25	-.016
All honors	64	6.94	7.31	-.375
Weighted grade average				
Math	63	2.41	2.49	-.077
Science	64	2.52	2.66	-.138
Technology	28	2.97	2.72	.245
Math + Science + Technology	64	2.52	2.61	-.096
JROTC[c]	-	-	-	-
All	64	2.78	2.80	-.022
Percentage of courses passed				
Math + Science + Technology	64	90%	89%	.3%
All	64	93%	92%	1.6%
Percentage yes				
Successfully completed biology, chemistry, and physics	64	42%	45%	-3.1%
Successfully completed algebra 2 or higher math course	64	91%	88%	3.1%

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 64 STARBASE students were compared to 64 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

[c] *There were not any statistically significant results.*

Note. *Includes 9th, 10th, 11th and the first semester of 12th grade SPPS records for the 12th grade cohort.*

A31. 12th grade cumulative (senior high school) highest math course passed

	N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]	Calculus
STARBASE	62	2%	2%	5%	26%	36%	31%
Comparison	62	-	5%	7%	18%	45%	26%

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th, 10th, 11th and the first semester of 12th grade SPPS records for the 12th grade cohort.*

A32. 12th grade cumulative (senior high school) STEM momentum

	N	Sufficient	Modest	Minimal	Weak
STARBASE	64	52%	23%	13%	13%
Comparison	64	55%	23%	3%	19%

Notes. *1) Includes 9th, 10th, 11th and the first semester of 12th grade SPPS records for the 12th grade cohort.*

2) STEM momentum categories include the following: Sufficient: student reached a level of math beyond algebra 2 and successfully completed three or more core lab science classes (i.e., biology, chemistry, or physics), Modest: student reached a level of math equivalent to algebra 2 and successfully completed three or more core lab science classes or student reached a level of math beyond algebra 2 and successfully completed two core lab science classes, Minimal: student reached a level of math equivalent to algebra 2 and successfully completed two core lab science classes, and Weak: student fell short of the above criteria.

A33. Attendance, 2007-08 school year

Subgroup	Group	N	Percentage of students chronically absent[a]	Number of days absent	Difference & significance
All	STARBASE	417	25%	8.3	-1.2*
	Comparison	417	30%	9.5	
High dosage	STARBASE	335	24%*	8.1	-1.2
	Comparison	335	30%	9.3	
Low dosage	STARBASE	81	31%	9.2	-0.7
	Comparison	81	30%	9.9	
10th grade	STARBASE	207	26%	8.4	-0.6
	Comparison	207	25%	9.0	
11th grade	STARBASE	132	27%*	8.4	-1.8
	Comparison	132	37%	10.2	
12th grade	STARBASE	78	23%	8.2	-1.4
	Comparison	78	33%	9.6	

* *p<.05*

[a] *Chronically absent is defined as being absent for 11 or more days during a single school year.*

Note. *Includes only students who were enrolled 160 or more days during the 2007-08 school year.*

A34. Math achievement level and scaled scores (MCA or MCA-II)

				Level scores				Scaled scores		
Cohort	Group	Test	N	Exceeds standards	Meets standards	Partially meets standards	Does not meet standards	N	Average score	Difference & significance[d]
10th grade[a]	STARBASE	MCA	192	10%	37%	32%	21%	189	848	-1.0
	Comparison	MCA	192	13%	33%	34%	20%	189	849	
11th grade[b]	STARBASE	MCA	113	10%	41%	32%	18%	113	849	1.0
	Comparison	MCA	113	12%	35%	28%	25%	113	848	
12th grade[c]	STARBASE	MCA-II	75	5%	15%	21%	59%	75	1136	-3.4
	Comparison	MCA-II	75	4%	21%	25%	49%	75	1139	

[a] *The 10th grade cohort took the MCA math achievement test in 8th grade in 2007.*

[b] *The 11th grade cohort took the MCA math achievement test in 8th grade in 2006.*

[c] *The 12th grade cohort took the MCA-II math achievement test in 11th grade in 2008.*

[d] *There were not any statistically significant results.*

A35. Math achievement level and scaled scores (MCA or MCA-II) by dosage

			Level scores				Scaled scores		
Subgroup	Group	N	Exceeds standards	Meets standards	Partially meets standards	Does not meet standards	N	Average score	Difference & significance[d]
High dosage MCA[a,b]	STARBASE	252	11%	39%	33%	18%	250	849	0.1
	Comparison	252	12%	37%	31%	20%	250	849	
Low dosage MCA[a,b]	STARBASE	53	8%	34%	26%	32%	52	845	-1.9
	Comparison	53	13%	21%	36%	30%	52	847	
High dosage MCA-II[c]	STARBASE	57	7%	14%	23%	56%	57	1136	-3.4
	Comparison	57	4%	23%	25%	49%	57	1139	
Low dosage MCA-II[c]	STARBASE	18	-	17%	17%	67%	18	1135	-3.6
	Comparison	18	6%	17%	28%	50%	18	1139	

[a] *The 10th grade cohort took the MCA math achievement test in 8th grade in 2007.*

[b] *The 11th grade cohort took the MCA math achievement test in 8th grade in 2006.*

[c] *The 12th grade cohort took the MCA-II math achievement test in 11th grade in 2008.*

[d] *There were not any statistically significant results.*

A36. 8th grade cumulative (junior high school) outcome measures by dosage

	Dosage	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count					
Math	High dosage	129	2.16	2.16	-.008
	Low dosage	32	2.31	2.06	.250
Science	High dosage	129	2.05	2.04	.008
	Low dosage	32	2.06	2.06	-
Technology	High dosage	129	0.01	0.13	-.124
	Low dosage	32	0.06	0.13	-.063
Math + Science + Technology	High dosage	129	4.21	4.33	-.124
	Low dosage	32	4.44	4.25	.188
Math honors	High dosage	129	0.26	0.26	-
	Low dosage	32	0.22	0.22	-
Science honors	High dosage	129	0.60	0.57	.039
	Low dosage	32	0.53	0.38	.156
Math + Science honors	High dosage	129	0.86	0.82	.039
	Low dosage	32	0.75	0.59	.156
All honors	High dosage	129	2.52	2.22	.302
	Low dosage	32	1.97	1.53	.438
Weighted grade average					
Math	High dosage	127	2.57	2.51	.052
	Low dosage	32	2.16	2.31	-.149
Science	High dosage	129	3.06	2.75	.307*
	Low dosage	32	2.43	2.55	-.122
Math + Science	High dosage	129	2.81	2.64	.171
	Low dosage	32	2.30	2.44	-.144
All	High dosage	129	3.01	2.88	.121
	Low dosage	32	2.49	2.68	-.188
Percentage of courses passed					
Math + Science + Technology	High dosage	129	94%	92%	1.6%
	Low dosage	32	89%	90%	-1.2%
All	High dosage	129	94%	94%	.3%
	Low dosage	32	90%	92%	-1.1%

* *p<.05*

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 129 STARBASE students were compared to 129 comparison students).*

Note. *Includes 7th and 8th grade SPPS records for the 10th grade cohort.*

A37. 8th grade cumulative (junior high school) highest math course passed by dosage

		N	General Math	Algebra 1	Geometry
High dosage	STARBASE	124	57%	34%	10%
	Comparison	124	54%	40%	6%
Low dosage	STARBASE	30	80%	13%	7%
	Comparison	30	70%	23%	7%

Note. *Includes 7th and 8th grade SPPS records for the 10th grade cohort.*

A38. 9th grade outcome measures by dosage

	Dosage	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count					
Math	High dosage	341	0.93	0.94	-.015
	Low dosage	80	0.91	0.95	-.038
Science	High dosage	341	0.94	0.91	.026
	Low dosage	80	0.91	0.96	-.050
Technology	High dosage	341	0.28	0.28	.006
	Low dosage	80	0.30	0.25	.050
Math + Science + Technology	High dosage	341	2.14	2.13	.018
	Low dosage	80	2.13	2.16	-.038
Lab sciences[b]	High dosage	341	0.25	0.27	-.023
	Low dosage	80	0.21	0.28	-.063
JROTC	High dosage	341	0.13	0.13	-
	Low dosage	80	0.15	0.13	.025
Math honors	High dosage	341	0.29	0.26	.029
	Low dosage	80	0.24	0.33	-.088
Science honors	High dosage	341	0.33	0.33	.006
	Low dosage	80	0.28	0.25	.025
Technology honors	High dosage	341	0	0	-
	Low dosage	80	0	0	-
Math + Science honors	High dosage	341	0.62	0.59	.035
	Low dosage	80	0.51	0.58	-.063
All honors	High dosage	341	1.47	1.43	.041
	Low dosage	80	1.25	1.39	-.138

A38. 9th grade outcome measures by dosage (continued)

	Dosage	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Weighted grade average					
Math	High dosage	322	2.53	2.51	.022
	Low dosage	73	2.17	2.36	-.187
Science	High dosage	330	2.54	2.45	.093
	Low dosage	76	2.21	2.46	-.245
Technology	High dosage	28	2.38	2.38	.002
	Low dosage	10	3.05	2.90	.152
Math + Science + Technology	High dosage	337	2.51	2.46	.049
	Low dosage	77	2.19	2.38	-.191
JROTC	High dosage[c]	-	-	-	-
	Low dosage[c]	-	-	-	-
All	High dosage	343	2.65	2.59	.059
	Low dosage	77	2.37	2.54	-.171
Percentage of courses passed					
Math + Science + Technology	High dosage	337	88%	87%	1.1%
	Low dosage	79	80%	88%	-7.7%
All	High dosage	343	90%	89%	1.2%**
	Low dosage	80	85%	91%	-5.6%
Percentage yes					
Successfully completed algebra 2 or higher math	High dosage	341	7%	7%	-.8%
	Low dosage	80	6%	10%	-3.7%

** *p<.01*

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 322 STARBASE students were compared to 322 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

Note. *Includes 9th grade SPPS records for the 10th, 11th, and 12th grade cohorts.*

A39. 9th grade highest math course passed by dosage

		N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]
High dosage	STARBASE	279	2%	55%	36%	7%	1%
	Comparison	279	3%	61%	28%	8%	<1%
Low dosage	STARBASE	63	5%	64%	25%	6%	-
	Comparison	63	3%	56%	30%	8%	3%

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th grade SPPS records for the 10th, 11th, and 12th grade cohorts.*

A40. 10th grade cumulative outcome measures by dosage

	Dosage	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count					
Math	High dosage	157	1.89	1.90	-.013
	Low dosage	35	1.97	1.94	.029
Science	High dosage	157	1.90	1.88	.019
	Low dosage	35	2.00	2.01	-.057
Technology	High dosage	157	0.55	0.72	-.172
	Low dosage	35	0.49	0.43	.057
Math + Science + Technology	High dosage	157	4.33	4.50	-.166
	Low dosage	35	4.46	4.43	.029
Lab sciences[b]	High dosage	157	1.18	1.22	-.038
	Low dosage	35	1.23	1.26	-.029
JROTC	High dosage	157	0.24	0.20	.038
	Low dosage	35	0.17	0.23	-.057
Math honors	High dosage	157	0.76	0.63	.134*
	Low dosage	35	0.54	0.63	-.086
Science honors	High dosage	157	0.74	0.71	.025
	Low dosage	35	0.83	0.57	.257*
Technology honors	High dosage	157	0	0	-
	Low dosage	35	0	0	-
Math + Science honors	High dosage	157	1.50	1.34	.159
	Low dosage	35	1.37	1.20	.171
All honors	High dosage	157	3.36	3.21	.147
	Low dosage	35	3.57	2.97	.600

A40. 10th grade cumulative outcome measures by dosage (continued)

	Dosage	N[a]	Mean		Difference & significance
			STARBASE	Comparison	
Weighted grade average					
Math	High dosage	154	2.41	2.41	.002
	Low dosage	34	2.45	2.63	-.176
Science	High dosage	154	2.60	2.47	.130
	Low dosage	35	2.60	2.72	-.114
Technology	High dosage	38	2.62	2.75	-.129
	Low dosage[c]	-	-	-	-
Math + Science + Technology	High dosage	156	2.52	2.46	.059
	Low dosage	35	2.55	2.65	-.099
JROTC	High dosage[c]	-	-	-	-
	Low dosage	-	-	-	-
All	High dosage	157	2.69	2.59	.103
	Low dosage	35	2.70	2.81	-.114
Percentage of courses passed					
Math + Science + Technology	High dosage	156	88%	87%	1.2%
	Low dosage	35	89%	93%	-4.4%
All	High dosage	157	91%	89%	1.6%
	Low dosage	35	92%	94%	-2.1%
Percentage yes					
Successfully completed algebra 2 or higher math	High dosage	157	47%	34%	12.1%**
	Low dosage	35	46%	37%	8.6%

* *p<.05*

** *p<.01*

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 193 STARBASE students were compared to 193 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

Note. *Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

A41. 10th grade cumulative highest math course passed by dosage

		N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]	Calculus
High dosage	STARBASE	148	1%	12%	39%	39%	9%	1%
	Comparison	148	2%	14%	49%	26%	8%	1%
Low dosage	STARBASE	33	3%	9%	39%	36%	12%	-
	Comparison	33	-	9%	52%	33%	6%	-

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

A42. 10th grade cumulative STEM momentum by dosage

		N	Sufficient	Modest	Minimal	Weak
High dosage	STARBASE	157	1%	8%	12%	80%
	Comparison	157	-	6%	15%	78%
Low dosage	STARBASE	35	-	9%	11%	80%
	Comparison	35	-	6%	20%	74%

Notes. *1) Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

2) STEM momentum categories include the following: Sufficient: student reached a level of math beyond algebra 2 and successfully completed three or more core lab science classes (i.e., biology, chemistry, or physics), Modest: student reached a level of math equivalent to algebra 2 and successfully completed three or more core lab science classes or student reached a level of math beyond algebra 2 and successfully completed two core lab science classes, Minimal: student reached a level of math equivalent to algebra 2 and successfully completed two core lab science classes, and Weak: student fell short of the above criteria.

A43. 12th grade cumulative by dosage

	Dosage	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Course count					
Math	High dosage	48	3.69	3.75	-.063
	Low dosage	16	3.94	3.88	.063
Science	High dosage	48	3.67	3.71	-.042
	Low dosage	16	4.19	3.69	.500**
Technology	High dosage	48	1.29	1.42	-.125
	Low dosage	16	0.81	0.63	.188
Math + Science + Technology	High dosage	48	8.65	8.88	-.229
	Low dosage	16	8.94	8.19	.750
Lab sciences[b]	High dosage	48	2.67	2.85	-.188
	Low dosage	16	3.31	2.89	.438*
JROTC	High dosage	48	0.40	0.33	.063
	Low dosage	16	0.13	0.38	-.250
Math honors	High dosage	48	1.69	1.75	-.063
	Low dosage	16	1.63	1.81	-.188
Science honors	High dosage	48	1.48	1.50	-.021
	Low dosage	16	1.63	1.19	.438
Technology honors	High dosage	48	0.06	0.09	-.021
	Low dosage	16	-	-	-
Math + Science + Technology honors	High dosage	48	3.23	3.33	-.104
	Low dosage	16	3.25	3.00	.250
All honors	High dosage	48	6.83	7.38	-.542
	Low dosage	16	7.25	7.13	.125
Weighted grade average					
Math	High dosage	47	2.46	2.47	-.016
	Low dosage	16	2.26	2.52	-.257
Science	High dosage	48	2.53	2.63	-.105
	Low dosage	16	2.51	2.75	-.237
Technology	High dosage	23	2.86	2.84	.025
	Low dosage[c]	-	-	-	-
Math + Science + Technology	High dosage	48	2.54	2.61	-.074
	Low dosage	16	2.44	2.60	-.162
JROTC	High dosage[c]	-	-	-	-
	Low dosage	-	-	-	-
All	High dosage	48	2.79	2.77	.011
	Low dosage	16	2.75	2.88	-.121

A43. 12th grade cumulative by dosage (continued)

	Dosage	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Percentage of courses passed					
Math + Science + Technology	High dosage	48	90%	89%	.7%
	Low dosage	16	90%	91%	-.8%
All	High dosage	48	93%	91%	2.4%
	Low dosage	16	94%	94%	-.6%
Percentage yes					
Successfully completed biology, chemistry, and physics	High dosage	48	35%	42%	-6.3%
	Low dosage	16	63%	56%	6.2%
Successfully completed algebra 2 or higher math	High dosage	48	88%	90%	-2.1%
	Low dosage	16	100%	81%	18.7%

* *p<.05*

** *p<.01*

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 48 STARBASE students were compared to 48 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

Note. *Includes 9th, 10th, 11th and the first semester of 12th grade SPPS records for the 12th grade cohort.*

A44. 12th grade cumulative (senior high school) highest math course passed by dosage

		N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]	Calculus
High dosage	STARBASE	48	2%	2%	7%	20%	41%	28%
	Comparison	48	-	4%	4%	20%	50%	22%
Low dosage	STARBASE	16	-	-	-	44%	19%	38%
	Comparison	16	-	6%	13%	13%	31%	38%

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th, 10th, 11th and the first semester of 12th grade SPPS records for the 12th grade cohort.*

A45. 12th grade cumulative (senior high school) STEM momentum by dosage

		N	Sufficient	Modest	Minimal	Weak
High dosage	STARBASE	48	52%	19%	13%	17%
	Comparison	48	56%	23%	4%	17%
Low dosage	STARBASE	16	50%	38%	13%	-
	Comparison	16	50%	25%	-	25%

Notes. *1) Includes 9th, 10th, 11th and the first semester of 12th grade SPPS records for the 12th grade cohort.*

2) STEM momentum categories include the following: Sufficient: student reached a level of math beyond algebra 2 and successfully completed three or more core lab science classes (i.e., biology, chemistry, or physics), Modest: student reached a level of math equivalent to algebra 2 and successfully completed three or more core lab science classes or student reached a level of math beyond algebra 2 and successfully completed two core lab science classes, Minimal: student reached a level of math equivalent to algebra 2 and successfully completed two core lab science classes, and Weak: student fell short of the above criteria.

A46. 9th grade outcome measures by cohort

	Cohort	N[a]	Mean: STARBASE	Mean: Comparison	Difference & significance
Course count					
Math	10th grade	222	0.91	0.93	-.014
	11th grade	132	0.93	0.95	-.015
	12th grade	68	0.94	1.00	-.059
Science	10th grade	222	0.91	0.91	-.009
	11th grade	132	0.96	0.90	.061
	12th grade	68	0.96	0.97	-.015
Technology	10th grade	222	0.30	0.26	.036
	11th grade	132	0.27	0.23	.030
	12th grade	68	0.28	0.37	-.088
Math + Science + Technology	10th grade	222	2.12	2.10	.014
	11th grade	132	2.16	2.08	.076
	12th grade	68	2.18	2.34	-.162
Lab sciences[b]	10th grade	222	0.23	0.26	-.032
	11th grade	132	0.22	0.22	-
	12th grade	68	0.34	0.43	-.088
JROTC	10th grade	222	0.13	0.13	-.005
	11th grade	132	0.14	0.13	.008
	12th grade	68	0.13	0.10	.029
Math honors	10th grade	222	0.27	0.30	-.023
	11th grade	132	0.30	0.24	.061
	12th grade	68	0.24	0.24	-
Science honors	10th grade	222	0.28	0.29	-.009
	11th grade	132	0.36	0.33	.030
	12th grade	68	0.37	0.34	.029
Technology honors	10th grade	222	-	-	-
	11th grade	132	-	-	-
	12th grade	68	-	-	-
Math + Science honors	10th grade	222	0.56	0.59	-.032
	11th grade	132	0.67	0.58	.091
	12th grade	68	0.60	0.57	.029
All honors	10th grade	222	1.32	1.41	-.090
	11th grade	132	1.58	1.30	.280
	12th grade	68	1.44	1.65	-.206

A46. 9th grade outcome measures by cohort (continued)

	Cohort	N[a]	Mean STARBASE	Mean Comparison	Difference & significance
Weighted grade average					
Math	10th grade	205	2.45	2.45	.003
	11th grade	128	2.48	2.43	.053
	12th grade	63	2.46	2.69	-.222
Science	10th grade	217	2.40	2.49	-.095
	11th grade	125	2.58	2.29	.294*
	12th grade	65	2.53	2.58	-.051
Technology	10th grade	22	2.24	2.34	-.107
	11th grade[c]	-	-	-	-
	12th grade[c]	-	-	-	-
Math + Science + Technology	10th grade	219	2.39	2.45	-.052
	11th grade	131	2.51	2.35	.166
	12th grade	65	2.52	2.64	-.126
JROTC	10th grade[c]	-	-	-	-
	11th grade[c]	-	-	-	-
	12th grade[c]	-	-	-	-
All	10th grade	222	2.52	2.59	-.063
	11th grade	132	2.68	2.47	.212*
	12th grade	67	2.65	2.74	-.092
Percentage of courses passed					
Math + Science + Technology	10th grade	220	85%	87%	-2.2%
	11th grade	131	87%	85%	2.1%
	12th grade	66	90%	90%	-.5%
All	10th grade	224	88%	90%	-1.8%
	11th grade	132	90%	87%	3.2%*
	12th grade	68	91%	91%	-.3%
Percentage yes					
Successfully completed algebra 2 or higher math	10th grade	222	8%	8%	.4%
	11th grade	132	7%	8%	-.8%
	12th grade	68	-	9%	-8.8%

* *p<.05*

[a] Refers to the number in each group of the matched pairs comparison (e.g., 222 STARBASE students were compared to 222 comparison students).

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

Note. *Includes 9th grade SPPS records for the 10th, 11th, and 12th grade cohorts.*

A47. 9th grade highest math course passed by cohort

		N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]
10th grade	STARBASE	175	2%	58%	29%	10%	1%
	Comparison	175	3%	61%	27%	8%	1%
11th grade*	STARBASE	112	2%	55%	37%	5%	2%
	Comparison	112	2%	63%	27%	8%	1%
12th grade	STARBASE	56	4%	55%	41%	-	-
	Comparison	56	2%	55%	32%	9%	2%

* *p<.05*

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th grade SPPS records for the 10th, 11th, and 12th grade cohorts.*

A48. 10th grade cumulative outcome measures by cohort

	Cohort	N[a]	Mean		Difference & significance
			STARBASE	Comparison	
Course count					
Math	11th grade	127	1.91	1.91	-.008
	12th grade	66	1.89	1.92	-.030
Science	11th grade	127	1.94	1.91	.039
	12th grade	66	1.86	1.92	-.061
Technology	11th grade	127	0.55	0.69	-.142
	12th grade	66	0.52	0.61	-.091
Math + Science + Technology	11th grade	127	4.40	4.51	-.110
	12th grade	66	4.27	4.45	-.182
Lab sciences[b]	11th grade	127	1.18	1.17	.008
	12th grade	66	1.21	1.33	-.121
JROTC	11th grade	127	0.21	0.20	.016
	12th grade	66	0.24	0.21	.030
Math honors	11th grade	127	0.73	0.63	.102
	12th grade	66	0.70	0.62	.076
Science honors	11th grade	127	0.75	0.69	.063
	12th grade	66	0.76	0.68	.076
Technology honors	11th grade	127	-	-	-
	12th grade	66	-	-	-
Math + Science honors	11th grade	127	1.48	1.32	.165
	12th grade	66	1.45	1.30	.152
All honors	11th grade	127	3.43	3.00	.425
	12th grade	66	3.29	3.44	-.152

A48. 10th grade cumulative outcome measures by cohort (continued)

	Cohort	N[a]	Mean		Difference & significance
			STARBASE	Comparison	
Weighted grade average					
Math	11th grade	125	2.44	2.37	.068
	12th grade	64	2.36	2.56	-.208
Science	11th grade	125	2.65	2.46	.192
	12th grade	65	2.49	2.59	-.105
Technology	11th grade	30	2.83	2.82	.013
	12th grade	16	2.73	2.76	-.035
Math + Science + Technology	11th grade	127	2.56	2.44	.121
	12th grade	65	2.45	2.58	-.131
JROTC	11th grade[c]	-	-	-	-
	12th grade[c]	-	-	-	-
All	11th grade	127	2.72	2.55	.170
	12th grade	66	2.63	2.76	-.126
Percentage of courses passed					
Math + Science + Technology	11th grade	127	88%	87%	.7%
	12th grade	65	88%	88%	-.3%
All	11th grade	127	91%	89%	1.8%
	12th grade	66	90%	91%	-.3%
Percentage yes					
Successfully completed algebra 2 or higher math	11th grade	127	49%	34%	14.9%**
	12th grade	66	41%	36%	4.5%

** *p<.01*

[a] *Refers to the number in each group of the matched pairs comparison (e.g., 193 STARBASE students were compared to 193 comparison students).*

[b] *Lab sciences include biology, chemistry, and physics.*

[c] *Sample size too small to report (N<10).*

Note. *Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

A49. 10th grade cumulative highest math course passed by cohort

		N	General Math	Algebra 1	Geometry	Algebra 2	Pre-Calculus[a]	Calculus
11th grade	STARBASE	122	1%	12%	37%	41%	9%	1%
	Comparison	122	2%	14%	50%	27%	7%	1%
12th grade	STARBASE	60	2%	12%	43%	33%	10%	-
	Comparison	60	2%	10%	50%	28%	10%	-

[a] *Pre-calculus also includes trigonometry and statistics.*

Note. *Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

A50. 10th grade cumulative STEM momentum by cohort

		N	Sufficient	Modest	Minimal	Weak
11th grade	STARBASE	127	1%	8%	9%	82%
	Comparison	127	-	5%	14%	81%
12th grade	STARBASE	66	-	8%	17%	76%
	Comparison	66	-	9%	20%	71%

Notes. *1) Includes 9th and 10th grade SPPS records for 11th and 12th grade cohorts.*

2) STEM momentum categories include the following: Sufficient: student reached a level of math beyond algebra 2 and successfully completed three or more core lab science classes (i.e., biology, chemistry, or physics), Modest: student reached a level of math equivalent to algebra 2 and successfully completed three or more core lab science classes or student reached a level of math beyond algebra 2 and successfully completed two core lab science classes, Minimal: student reached a level of math equivalent to algebra 2 and successfully completed two core lab science classes, and Weak: student fell short of the above criteria.