BEC *STEM Connect*™ Program Impact Report

August 2016

Presented by:

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BEC *STEM Connect*™
2016 Program Impact Report

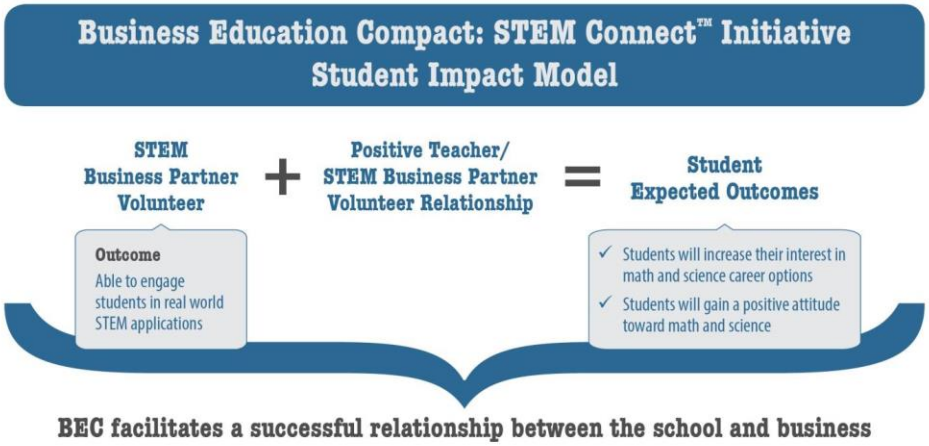
Acknowledgements

This report is informed by the implementation of an evaluation plan designed by our independent evaluator, CRSmith Consulting. Special thanks to the Oregon Community Foundation whose funding over the past two program years has established a solid foundation for on-going program evaluation. Thanks also to the faculty and students across the five schools that participated in student evaluation activities, the volunteers and sponsoring companies and Dr. Timothy Ho, Research Associate, NPC Research who worked in collaboration with CRSmith Consulting to analyze student data.

Methodology

The BEC *STEM Connect*™ Initiative brings together community business partners and underserved neighborhood schools to inspire interest in math and science. By generating interest, the program seeks to create a pathway to STEM careers. The focus is on 4th and 5th grade classrooms, where research reports declining interest in math and science.

The evaluation investigated the impact of the program in two key areas: career interest and attitude. The expectation is that the students will: (1) improve their attitude/behavior toward math and science and (2) increase their interest in pursuing a math or science career. The student impact model below illustrates the relationships between teachers, STEM business partner volunteers, BEC and students, as well as the expected outcomes. It sets the foundation for the evaluation.



Four key methodologies were employed to measure key outcomes:

Fourth grade student pre/post student survey. The Attitude Toward Science in School Assessment (ATSSA) (Germann 1988) was administered to students in fall 2015 (pre) and spring 2016 (post). This instrument focused on science and was expanded to the topic of math for the purposes of this evaluation. Items added to the post-test captured students' thoughts on program components, as well as whether they felt their interest in math and science had changed as a result of the program. A total of 340 fourth-grade students across five schools completed the pre/post surveys. (They were a sampling of the almost 3,000 4th and 5th graders who participated this program year.) Evaluation schools had participated in *STEM Connect* for at least two years and had at least half of their student population was on free and reduced lunch. The actual number of responses varied item to item.

Fifth grade focus groups. A total of 26 fifth graders participated in these sessions which explored changes in attitudes toward STEM, as well as career interest. For most students, *STEM Connect* improved their attitude toward STEM and/or their interest in STEM-related careers. Several comments reflect this change:

> "Science isn't a subject I liked at school, but when STEM came along it was fun because I got to learn more about energy and motion. It made me like it more."
>
> "It made me like science and engineering a lot more than I used to. It really showed me how fun it could be."
>
> "STEM helped, pushed me to do more things I liked. Connecting science, engineering, math and technology with arts projects."

These findings offer insight into the ways in which the program impacted students. Four categories emerged that summarize students' attitude and interest toward STEM—both before and after the program. These groupings may be helpful to BEC in continued program development and implementation.

1) Interest improved: most students reported their interest in STEM academics and/or careers improved because of *STEM Connect*.
2) Previously interested/ interest strengthened**:** some students reported previous interest existed before *STEM Connect*.
3) Previously identified non-STEM career/ interest improved: some student reported they already chose non-STEM careers.
4) No interest/ no change: few students reported having no academic or career interest before or after *STEM Connect*.

Summative surveys. Both teachers and volunteers completed a summative survey that captured their thoughts about student engagement, overall student impact, as well as program implementation feedback.

In addition to highlighting the impact BEC *STEM Connect* made in the 2015-16 school year, this report also addresses how data will be used for program improvement.

Student Outcomes

As in the 2014-15 program year, aggregate post-test scores did not change much. This result was likely due to the high pre-test scores. To dig deeper, the same tests were run on a subset of students who had a negative or neutral attitude toward math and science in the pre-test. Results showed positive gains for these students.

The focus group results were consistent with the survey results, further validating the positive impact *STEM Connect* had on students. After two years of the program, focus group results suggest most students did improve their attitude and/or career interest toward STEM. It's clear that the program investment is converting some students who initially did not like math and/or science.

Fifth grade students' attitudes varied toward STEM academics and career interest. These differences provoke the following questions:

- How can students who have already decided on a non-STEM career be inspired academically?
- How can volunteers strengthen the interest for students who are already on the STEM career path?
- For the very few who show no interest in STEM at all, how can volunteers reach them?

BEC staff and volunteers may consider exploring answers to these questions together to best inform classroom instruction.

The need to be more explicit about math was evident. Student comments further confirm there was a lack of explicit math language as summarized by the following statement, "I feel the same about math because when the volunteers came they talked about science and not math." BEC staff and volunteers may work together to integrate math principles into the *STEM Connect* curriculum. This will connect math to science, and may improve students' attitude toward math to a greater degree.

Key student outcomes and survey results follow.

Outcome: Students will improve their attitudes/ behavior toward math, science and related careers.

For all students, interest increased more so for science than math. This is consistent with focus groups where students shared that their interest in science and/or math changed because of *STEM Connect*. For students with little interest in science and math in the pre-test, there were significantly positive changes. These gains could make a great difference on how these students approach math and science in the coming years.

Post-test results also show positive findings as illustrated in the table that follows:

✓ 67% (of 340 students) reported being more interested in science because of the STEM program	*"I didn't enjoy math but now I love math."*
✓ 40% (of 20 students) with neutral or negative attitude toward science in the pre-test were more interested in science because of the STEM program	*"Math is fun because it makes me learn."*
✓ 46% (out of 340) reported being more interested in math because of the STEM program	*"They made science really interesting and fun . . . I want them to stay more."*
✓ 30% (out of 64) with neutral or negative attitude toward math in the pre-test showed improved attitude in the post-test	*"Science was sometimes boring, but now I like science."*

Outcome: Students will increase their interest in pursuing a STEM-related career.

Focus group results revealed for some students that their interest didn't increase because it already existed. Instead, the program strengthened their interest. Student survey results aggregate scores showed no marked improvement in interest about jobs in science or math. As with measuring changes in attitude, this too is likely due to the high pre-test scores. Interestingly, tests run with a subset of students who had negative or neutral results showed increased interest.

Post-test results also illustrate positive changes as follows:

✓ 78% of students (out of 46) who had neutral or negative responses regarding jobs in science showed an increase in interest in the post-test	*"When I grow up I want to be a vet that includes math and science."*
✓ 64% (out of 86) who had neutral or negative responses regarding jobs in math showed an increase in interest in the post-test	*"Math is better than I thought it would be."*

Outcome: Students will report that STEM business partner volunteer activities and presentations are engaging.

Post-test results showed this outcome was met. Students were overwhelmingly positive about the volunteers.

✓ 83% of students reported that hands-on activities were interesting or very interesting	*"I want it to come next year."*
✓ 78% of students reported volunteers were interesting or very interesting	*"I felt happy when the volunteers came here."*
✓ 74% of students reported presentations were interesting or very interesting	*"I want STEM [volunteers] to keep coming to our class so I can be more interested."*

Ultimately, *STEM Connect* continues to improve attitudes toward STEM and increase interest in STEM-related careers. This puts students on a path to success, whether it is a more fruitful educational experience as they pursue non-STEM careers, openness to the possibilities of STEM related careers and/or a strengthening of commitment to STEM careers as they continue to grow, learn and explore.

Teacher and Volunteer Outcomes

In June 2016 teacher and volunteer summative surveys were administered:

- Teacher summative survey: 42 participants, a response rate of 35%
- Volunteer summative survey: 44 participants, a response rate of 30%

In order to increase teacher response rates surveys were administered earlier. While the teacher response rate increased, the volunteer response rate was lower than the prior year. BEC staff will work to remind all participants of the importance of this data as it informs program growth and development. Many thanks to those that completed the survey—we value your input!

Following are outcomes as they pertain to both our evaluation plan and with the overarching goal of engaging students in STEM.

Overarching Program Goal: Volunteers will engage students in real world STEM applications.

Student engagement is an outcome addressed in all data collection tools for teachers, volunteers and students. It is key to the program's success. Teacher and volunteer summative surveys support that this goal was met.

Overall teachers and volunteers rated students' level of engagement high. Following are a sampling of comments teachers had about student engagement.

> "I have a couple of female students interested in going into engineering now because of the visits!"
>
> "My students had such a wonderful time engineering the jet cars. They also loved seeing our volunteer dressed up in a bunny suit, as well as the pictures of the clean lab. Engagement was high!"
>
> "It was really great to see kids enjoying working together to solve problems. A few [students] that were not good at cooperation stood out."

Following are Volunteer comments about student engagement.

> "The teacher shared that after we did the build a catapult that one student stayed in from recess to work on theirs."
>
> "The kids were amazingly engaged and experimented wildly using a lot of creativity."
>
> "At the end of our third and final visit, a student raised their hand and asked, "Can I be an Engineer like you one day?"

Outcome: Positive relationship between teacher and volunteer will be established.

Teachers (92%) and volunteers (83%) reported working relationship between themselves and volunteers was either very positive or positive.

> "When the STEM volunteers visited my classroom they were so supportive and really seemed to enjoy teaching the kids the marble roll. It was good for me to see how they left the directions for the students open ended so the kids were forced to work together to figure out as a group the best way to create their marble roll design."

"Our volunteers were terrific! All three were originally from Mexico and it was terrific for my Spanish Immersion students, particularly my Latin American students, to see role models of color. Thank you!"

Outcome: Teacher and STEM business partners will have regular contact.

Of the 44 volunteers who completed the survey, 63% visited the classroom 3 or more 4 times. Following is what one volunteer said about their desire to be in the classroom.

"… possibly encourage more visits early in the school year. If I had had the time in 2015-16, I would've loved to come out once a month/two months, to really get more involved with the teacher's program and spend time participating with the students in ongoing science/math learning."

Outcome: Business partners will become part of the school community.

Of the 44 volunteer survey participants, 42% reported they were involved with the event in the following ways: attended (39%), helped plan (33%) or presented (28%). Typically, the events were a STEM night of science fair. As one volunteer stated, "It not only showcased the work that was done during the school year but also got the younger kids excited about their participation in the *STEM Connect* program in the future."

Considerations:

- Positive: Those that were involved had positive comments to share.
- Challenge: 19% reported there wasn't a school-wide event, and 40% didn't know if there was one.

What we learned:

BEC staff needs to increase support to businesses and schools to engage them in the school-wide event.

Outcome: Teacher confidence in teaching STEM increased.

Confidence level in teaching STEM did not change for most teachers. For some, it improved (35%); for most (65%) there was no change.

More than half (62%) of teachers who responded stated their confidence level in teaching Science had improved slightly (22%), improved somewhat (10%), improved (30%).

Impact and Next Steps

Overall, survey results demonstrate *STEM Connect* had a positive impact on students. All volunteers and teachers reported they felt this was the case.

"The first project was great. Students were engaged and it was a good challenge for them."

Another volunteer observed the increased interest in STEM.

"The kids were very excited to see us each time, and were very enthusiastic about the STEM activities."

Program Implications

Communication: Volunteers and teachers commented that communication between the two groups was difficult. We believe that issue impacted the number of times volunteers came to the classroom.

- BEC will increase volunteer/ visit tracking to understand where we need to provide additional support.

Introduction visit: Some volunteers and teachers commented that it would be good to have a small activity for the first classroom visit.

- BEC will provide an activity for the first visit that engages students.

Additional resources: While volunteers reported high usage of BEC resources on the *STEM Connect* resources web page, teachers expressed desire to have resources that both front-load and extend the activities.

- BEC will increase teacher resources to include front-loading and extending *STEM Connect* activities.

Connection to standards: Teachers and volunteers requested the 5th grade activity align more closely to Next Generation Science Standards (NGSS).

- BEC's *STEM Connect* committee voted to change the 5th grade activity to a Water Filtration experiment that aligns with NGSS.

Teacher engagement: Teachers and volunteers expressed an interest in various levels of teacher engagement ranging from that of a support role to that of co-presenter.

- BEC will encourage volunteers and teachers to discuss expectations to understand the level of engagement with which a teacher feels comfortable.

Reference

Germann, P. J. (1988). "Development of the Attitude Toward Science in School Assessment and its Use to Investigate the Relationship Between Science Achievement and Attitude Toward Science in School." *Journal of Research in Science Teaching, 25*, 680-703.