STEM Action Center

Grant Program

Annual Evaluation Report

2015-2016

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Presented by

Michael Snyder, M.S., Utah State University

Department of Psychology

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For additional information about this report, contact:

Michael Snyder, Research Scientist
Department of Psychology
Utah State University
Old Main Hill, ECED 317
Logan, UT 84322
(435) 797-5519

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Chapter 1 - Executive Summary

Introduction

This report provides an analysis and evaluation of the programs and professional development opportunities funded by House Bills 139 and 150 for educators and students (i.e., K-12 digital mathematics technologies; career and technical education (CTE); professional development; fairs, camps, and competition (FCC); high school STEM industry certification; and elementary STEM endorsement). This executive summary contains brief descriptions of each grant program. Where applicable, highlights of student, teacher, and administrator survey responses and product usage are included. In addition, Students' SAGE assessment outcomes are reported for the K-12 math technology grant. Summaries of students' industry certifications and teachers' STEM endorsements are also reported. Following the executive summary, Table 1 contains the legislative language that created the STEM AC and funded these programs, while Figure 1 contains a logic model outlining the measured outcomes resulting from the evaluation.

K-12 Math Instructional Software

To supplement math instruction, nine software products (see Appendix B) were chosen through a competitive bidding process and were made available for local education agencies (LEAs) through a grant application. Of the 183,109 product licenses requested in 93 LEAs and 556 schools, 166,993 (91%) were approved. Impacts have been measured by comparing students' SAGE scores between those who met the vendor recommended usage level (fidelity) versus those who did not use the software. Teacher and student survey instruments were also used to measure perceptions regarding the various products. In total, 131,602 (79%) of licenses had greater than zero minutes of use, and 63,832 (49%) of these students used the math software with fidelity.

Many of the survey questions were designed to reveal students' self-perceptions related to math. The student survey was an adaptation of the work of Eccles and Wigfield (1995) who applied expectancy-value theory to a group of middle school math students. This theory showed a positive relationship between students' self-perceptions related to math and their academic motivation. Other research has shown that, while students' ability in mathematics increases over the year, their motivation decreases (Chouinard & Roy, 2008; Leder & Forgasz, 2002; Middleton et. al., 2004; Onatsu-Arvilommi & Nurmi, 2000; Watt, 2000). Thus, we would expect positive gains over an academic year on students' perceptions of ability, and yet, contrary to Eccles and Wigfield (1995), a decline in motivation may occur. Thus, we might expect a "cancelling" effect to take place, where students' abilities might increase, but their motivation to do mathematics may decrease. Therefore, the effects of the software on students' SAGE scores may be confounded by this cancelling effect.

This cancelling effect may also explain the small changes in student perceptions between the pre and post-surveys. In general, most K-6 students had positive perceptions toward math and the instructional software. The 7-12 student surveys indicated a dislike for math, while also showing that most students place a high priority on both their performance in math classes and the utility that math may play in their future careers.

Teachers experienced several barriers both inside and outside of the scope of the software grant. Many teachers requested more professional development (PD), which could be provided by the software vendors. Thus, it is recommended that the vendors work closely with LEAs to determine further PD opportunities. In addition, teachers reported technology access and internet browser issues as barriers. Despite these barriers, over 75% of teachers responded positively when asked about their satisfaction with the math instructional software.

Overall, both teachers and students liked the math software chosen by their school, using it to differentiate instruction for students at all levels. To further understand the association between LEAs software use and student outcomes, an analysis of students' SAGE scores was completed. The principal results from the analysis were the odds ratios (effect size) produced by the logistic regressions computed for the three pairwise compared groups: high fidelity (HF), or those students who used STEM AC funded software and exceeded the vendor defined fidelity benchmark; low fidelity (LF), or those students who used STEM AC funded software below the fidelity benchmark; and unfunded (UF), or those students who did not use STEM AC funded software. For the HF vs UF groups, the odds of proficiency on the math SAGE assessment were greater for students using ALEKS (≈1.2 times greater), ST Math (≈1.5 times greater), and Think Through Math (≈3 times greater) with HF. Two of these software products, ALEKS and Think Through Math, also had higher odds of proficiency for students using the software with HF versus those students who had LF. In this case the odds were ≈1.7 times greater for ALEKS and ≈2.4 times greater for Think Through Math. The final comparison, between LF and UF students, had a negative association for ALEKS and Catch Up Math users. This negative relationship means that UF students had greater odds of proficiency. In particular, unfunded students had ≈1.34 greater odds of proficiency compared to LF ALEKS users and ≈2.5 times greater odds compared to LF Catchup Math users.

These positive results come with some limitations resulting from possible bias contained with the data. For example, software use among students who were not funded by the STEM AC was not measured. It is possible that many of these students are using some form of math instructional software. This may have induced bias when comparing SAGE scores between these students and the STEM AC funded students. For a more in depth discussion regarding SAGE score results, see Appendix A.

Professional Development

School Improvement Network (SINET), a company providing professional learning products to schools, designed Edivate, which is an online video based professional development (PD) platform. This product provides example videos of expert lessons, a platform for teachers to share and reflect on videos of their own teaching, and collaborate with administrators and other teachers. Edivate was the only professional development product distributed to schools through the STEM Action Center (AC) professional development grant program.

Of the 280 teacher survey responses, 40% noted that they were satisfied with the online PD platform, while 33% indicated a negative perception, 19% a mixed perception, 5% were indecisive, and 3% found the product was not applicable. Of the survey responses, 60% of teachers noted that they used Edivate to find helpful teaching ideas and strategies. Of the 30 responses, many administrators' expressed satisfaction with Edivate's freedom and flexibility of content access for teachers, as well as the ability to collaborate, reflect, and analyze teaching methods and practices.

Of the 18,045 Edivate licenses distributed, 5,453 (30%) had some level of usage. Most Edivate usage barriers were outside the scope of the STEM AC's implementation of the PD software. These barriers include insufficient time to access the materials or a shortage of necessary equipment. Several actions may increase Edivate usage, including: greater promotion of Edivate as part of an LEAs overall annual professional development plan; an increase in the number of available STEM specific videos, which may be accomplished by encouraging more teachers to create their own videos; greater flexibility for teachers to watch videos of their choosing; and provide teachers with the opportunity to analyze, reflect, and collaborate during their professional learning communities.

CTE

The career and technical education (CTE) evaluation considered the effectiveness of four CTE curricula provided by: ITEEA, Pitsco, Project Lead the Way, and STEM Academy. Efficacy measures were collected through surveys gauging teachers' perceptions of curriculum implementation, including product specific professional development (PD). Overall, teachers stated that they were pleased with the CTE curriculum chosen by their local education agency (LEA). Consistent with past CTE curricula, students and teachers described their classrooms as places where students were free to question what and how they learned, enjoyed greater collaboration, and assess their own learning (National Education Association, 2016; The Partnership for 21st Century Learning, 2016). Teachers also noted that the CTE curriculum improved students' STEM skills and knowledge; however, the breadth of this curriculum caused many teachers to spend an excessive amount of time preparing each lesson. Although the vendor provided professional development, survey responses revealed that teachers thought more frequent and prolonged PD was necessary. Thus, we recommend expanding the currently available PD (Asunda, Finnell, & Berry, 2015; Kleickmann, et al., 2013; Mukembo & Edwards, 2015).

Vendor designed student assessment data provides some student outcome results. However, the optional nature of these assessments lead to two of the four vendors providing this data on a small subset of participating students. Students' SAGE scores were also to be analyzed, however, there was no way to identify which students used the product. Further, concerns over the suitability of SAGE assessment outcomes toward product efficacy arose (AERA, 2014; Cangelosi J. S., 2000). Therefore, an analysis of students' SAGE outcomes is excluded from this report.

Fairs, Camps, and Competitions

The STEM Action Center (AC) awarded grants to 1,248 students of up to $2,500. The grants were used to participate in science fairs or science projects, in STEM camps throughout Utah, and competitions at the local, regional, and national level. We received 548 completed surveys from students who received an award at the end of the academic year. The survey asked students about: their interaction with individuals currently working in STEM careers; what they learned in the fair, camp, or competition (FCC) in which they participated; what their career interests were; and how they shared what they learned.

Research has shown that a student's interaction with individuals in STEM careers may promote students' interest in STEM education (Sahin, Gulacar, & Stuessy, 2014). Approximately 70% of participants responded that they had a male relative or male acquaintance who worked in a STEM career, while 21% responded that they had a female acquaintance or relative. Promoting interaction with women in STEM careers may increase the number of female students who participate in and show interest in STEM careers.

When asked about their career interests, 31% of respondents mentioned engineering related careers, 16% mentioned technology or computer programming careers, and 13% medical careers. When asked what they learned in FCC, participants responded that they learned about robotics (24%), teamwork and collaboration (24%), general science (19%), computer programming (9%), and engineering (8%).

Students were also asked to discuss their plans to share what they learned in FCC. Of these, 47% of respondents indicated a desire to share their experiences in general, with family, or with peers. Additionally, 9% of respondents reported a desire to mentor younger students or attempt to recruit their peers. Many participating students reported: a reinforced desire to pursue STEM careers, improvement in STEM knowledge and skills, and a desire to share these skills with others. FCC provides students with informal collaborative inquiry-based experiences in STEM areas, which are not available in a typical classroom setting. Thus, we recommend providing these types of opportunities to students in the future.

STEM Endorsement Grants

The Elementary STEM Endorsement Grant provided funding for teachers to return to school and acquire additional training in STEM related subjects. The first cohort of approximately 322 teachers received 1.5 million dollars. The State Board of Education collaborated with the STEM Action Center to administer the STEM endorsement program (HB 150, 2014). To facilitate the program's objectives, seven partnerships between local education agencies (LEAs) and nearby institutes of higher education (IHEs) were arranged. Teachers eligible to return to school for STEM endorsement training did so through the university with whom their school district has partnered.

There are considerable differences in how the particulars of the program are administered across partnerships. For instance, in some partnerships the eligibility restrictions for teachers are based on "teaching and leadership experience" while other partnerships have "no recruitment criteria." Significant differences in the program's implementation will be considered when assessing the STEM endorsement program. Some of these differences include, but are not limited to, recruitment criteria, tuition, and method of delivery.

The STEM action center requires each partnership to conduct its own internal evaluation regarding the success of the STEM endorsement program within their educational precinct. To accomplish this, each partnership has chosen its own indicators to gauge the effectiveness of the program. For instance, some partnerships have chosen to consider the program's impact on a "teacher's level of participation in STEM education leadership" along with more traditional quantitative measures such as test scores.

In addition to the internal evaluations mentioned above, next year's STEM Endorsement evaluation shall ascertain the aggregate impact of the program on SAGE scores. The statistical methodology that will be employed is commonly known as "difference in difference" which consists of comparing the differences in SAGE scores of students whose teacher participated in the program with those that did not, both before and after the program's implementation. This technique is intended to help us identify a relationship between completing a STEM endorsement via the grant project and improved SAGE scores in the classroom. To assist in the evaluation process, a survey designed to elicit feedback on the effectiveness of the STEM endorsement program will be distributed to participating teachers.

High School STEM Industry Certification

Opportunities for high school students to earn industry certifications and provide pathways to internships was provided by the STEM Industry Certification grant program. From 2014 to 2016, these programs involved $3,882,962 funding 12 grants awarded to 17 LEA's, 14 universities and technical colleges, 44 industry partners, and over 6,900 students. This resulted in 4,791 certifications and 639 internships. Of the 4,791 certifications, 3,670 were for Microsoft Office Specialists. Excluding these, the following represent the remaining certifications:

Agriculture (38%), manufacturing (31%), CS/IT (19%), life sciences (7%), and engineering (5%).

Two of the twelve programs, AM STEM and Summit Academy STEM IT, ended in Spring 2015; for more information on these two programs, see last year's report (Brasiel & Martin, 2015).

Some teacher and student surveys were responses indicated a desire to expand such programs with more courses, equipment, and opportunities. Overall, those who earned certifications or worked with students felt the program was effective and expressed a desire to continue. Thus, we recommend continuing to find ways to provide students with pathways to industry certifications.

Legislation and Funding	Actual Language from Legislation
HB 139 Secondary Math $5 million for grades 6-8 math technology and PD and $3.5 million for college math-readiness technology and PD for grades 9-12.	*at least $5,000,000 of the appropriation for STEM Action Center be used for STEM education related instructional technology and related professional development to support mathematics instruction for students in grades 6, 7, or 8 as described in Subsection 63M-1-3205 (3)(a) and Section 63M-1-3206 , and related assessment, data collection, analysis, and reporting;* *at least $3,500,000 of the appropriation for STEM Action Center be used for STEM education related instructional technology and related professional development to support mathematics instruction for secondary students to prepare the secondary students for college mathematics courses as described in Subsection 63M-1-3205 (3)(b) and Section 63M-1-3206 , and related assessment, data collection, analysis, and reporting;*
HB 150 $5 million STEM instructional technology and PD used for K-5	*(1) up to $5,000,000 of the appropriation for the STEM Action Center program be used for STEM education related instructional technology and related professional development to support mathematics instruction as described in Subsection 63M-1-3205 (3)(a)(i) and Section 63M-1-3206 , and related assessment, data collection, analysis, and reporting;*
HB 150 $1.5 million for STEM Teacher Endorsements	*(2) up to $1,500,000 of the appropriation for the STEM Action Center program be used for developing the STEM education endorsements and related incentive program described in Section 63M-1-3208 ;*

Legislation and Funding	Actual Language from Legislation
HB 150 **$5 million STEM high quality PD**	*(3) up to $5,000,000 of the appropriation for the STEM Action Center program be used for providing a STEM education high quality professional development application as described in Section 63M-1-3209 ;*
HB 150 **$3.5 million STEM education middle school applied science**	*(4) up to $3,500,000 of the appropriation for the STEM Action Center program be used to fund the STEM education middle school applied science initiative described in Section 63M-1-3210 ;*
HB 150 **$5 million for High School STEM Education initiative**	*(5) up to $5,000,000 of the appropriation for the STEM Action Center program be used to fund the high school STEM education initiative described in Section 63M-1-3211*

Table 1. Language from HB 139 and HB 150 by Program

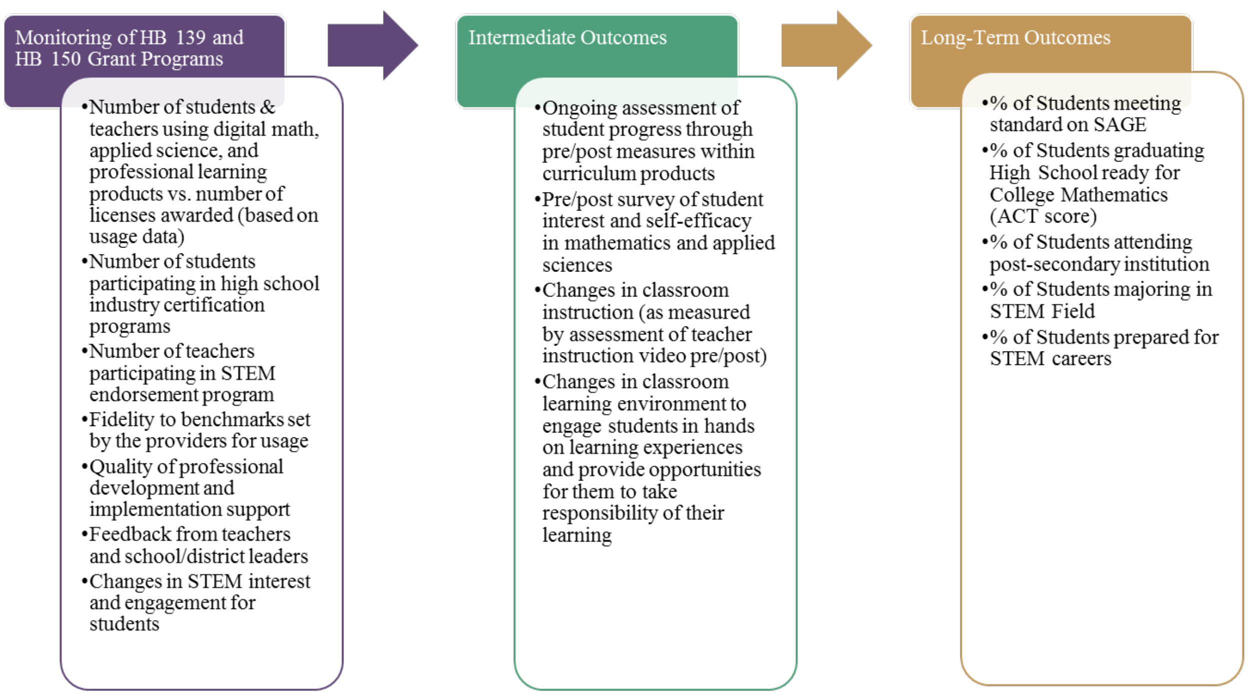
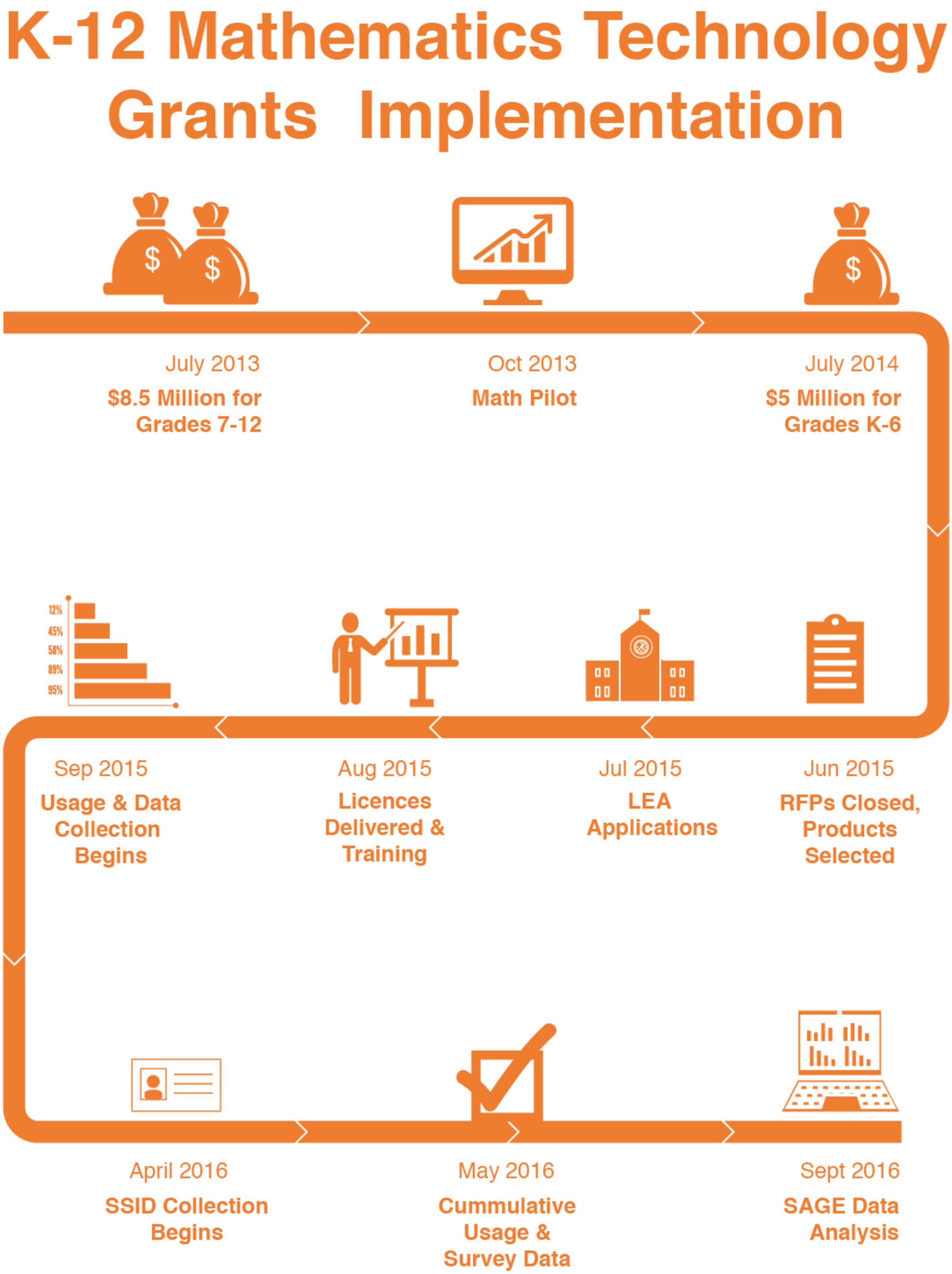
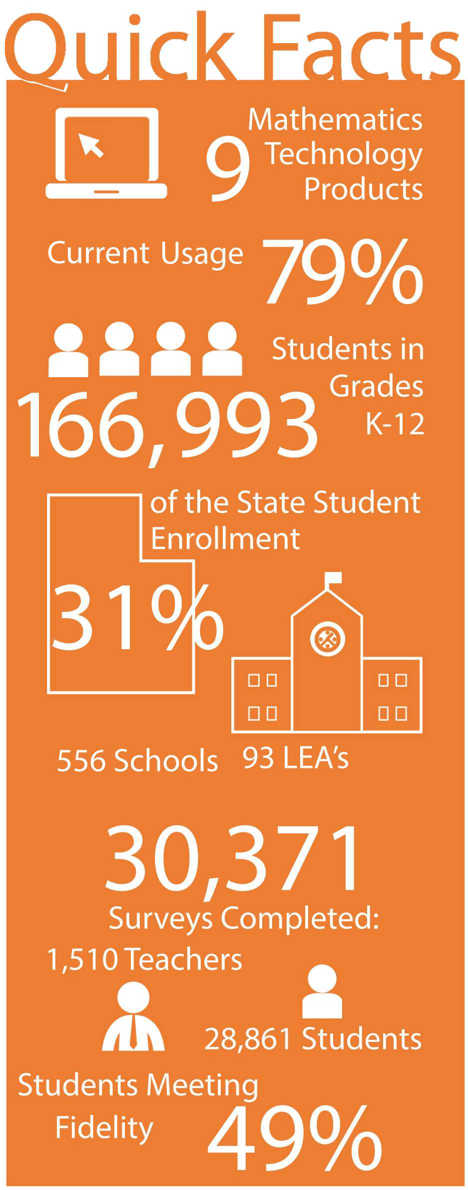


Figure 1. Logic Model for Evaluation of STEM Action Center Grant Programs

Chapter 2 – K-12 Math Technology Grants



Introduction



The Utah STEM Action Center awarded grants to local education agencies (LEAs) for mathematics instructional software (Brasiel & Martin, STEM Action Center Grant Program Annual Evaluation Report, 2015). Through a competitive bid process, nine software products were chosen and made available for selection by the granted LEAs. These include: ALEKS, Catchup Math, EdReady, iReady, Math XL, Reflex Math, ST Math, Successmaker, Think Through Math. See Appendix B for a more detailed description of each product.

At the time of implementation, 183,109 product licenses had been requested. Of which, 166,993 requests were filled in 93 LEAs and 556 schools, giving a 91% fulfillment rate.

To measure the impact of the instructional software, several data collection instruments were successfully deployed. These impacts have been measured by the following three data sources: student survey responses, teacher survey responses, and students' SAGE scores. All of these were analyzed to inform the efficacy of the nine software products. The groups of interest are those who received licenses and used the product.

The research questions guiding this evaluation are:

- Did the number of distributed licenses match the quantities requested by individual LEAs?
- To what extent do students use the software products to the level recommended by the vendor?
- To what extent do students participating in the STEM Action Center Mathematics Technology grant programs experience change in their interest and engagement in mathematics?
- To what extent do students participating in the STEM Action Center Mathematics Technology grant programs experience change in their perception of the value of mathematics?
- To what extent do students participating in the STEM Action Center Math Technology grant programs experience change in their perception of the difficulty of mathematics?

Students' SAGE assessment scores were used to investigate whether an association exists between math instructional software use at a specified fidelity level and student outcomes, as noted in Appendix A. In the math software grant program, vendors set a level of optimal use for their respective products. This measure varies by vendor and is called the fidelity level. Though there is variation in fidelity measure, it generally includes a specified minimum average number of minutes or average lessons completed on a weekly basis. This lower bound has been correlated to optimal student performance gains by research, which in some cases was performed by an independent third party research group. Thus, we would anticipate increased SAGE outcomes from those who have used the software with fidelity.

In total, 63,832 or 49% of participating students used the math software chosen by their LEA with fidelity. Participating students were defined as students with greater than zero minutes of use. Of which, there were 131,602 students. Dividing this number by the total number of licenses distributed, or 166,993, shows that approximately 79% of licenses were used.

The student survey follows Eccles and Wigfield (1995), who applied expectancy-value theory to a group of middle school math students. This theory was domain-specific to mathematics, and defined the relationship between students' values, abilities, and self-perceptions, and their motivations for completing mathematical tasks. In this evaluation, a survey instrument, designed by Eccles and Wigfield (1995), was administered to participating students to answer research questions related to students' self-perceptions of ability, task-difficulty, and task-value. In particular, these three self-perceptions have been correlated to changes in mathematical task motivation.

Also affecting students' self-perceptions, is the natural progression of motivation over the school year. Research has shown that, while students' ability in mathematics increases over the year, their motivation decreases (Chouinard & Roy, 2008; Leder & Forgasz, 2002; Middleton et. al., 2004; Onatsu-Arvilommi & Nurmi, 2000; Watt, 2000). Thus, we would expect positive gains over an academic year on students' perceptions of ability, and yet, contrary to Eccles and Wigfield (1995), a decline in motivation may occur. Thus, we might expect a "cancelling" effect to take place, where students' abilities might increase, but their motivation to do mathematics may decrease. Therefore, the effects of mathematical instructional software on students' SAGE scores may be confounded by this cancelling effect.

In addition to students' perceptions of mathematics, the survey gathered data regarding both students' and teachers' attitudes toward the math software and its implementation. In particular, survey items asked teachers about how they used the product, the professional development provided by the vendors, and any barriers they experienced toward product use. Students were asked what they liked about the software product chosen by their LEA. In the next section, we discuss the methods used to collect and analyze the student and teacher survey data.

Methods

Methods for Student Quantitative Data

Data Collection

For each grant program, we coordinated requests for data with the providers of the products on a monthly basis. We set up a secure portal for data transfer with upload-only access. Each month, the providers of each grant program uploaded data on the number of licenses distributed by providing an Excel or CSV file with user level data documenting the license username, school and district name, participant name, and any usage data available. Some products record usage data in minutes, hours, or days, while others record the number of student log-ins or the number of lessons completed. Data was also collected regarding the recommended level of use for each software product, which we refer to as a "fidelity of implementation benchmark," and will simply be referred to as "fidelity" throughout the remainder of this report. The fidelity measure varies by product and may include a recommended number of minutes of use, number of lessons completed, or some combination of both (see Table 2). We use fidelity data to summarize the number of students who met this benchmark. These benchmarks will also be used as a control variable in an analysis of student SAGE scores in an Appendix A to this report. The usage data that the provider sent us, includes a flag of "1" if the student met the fidelity benchmark and "0" if the student did not meet the benchmark.

Product (Provider)	Grades	Description of Benchmark
ALEKS (McGraw-Hill)	K-6, 7-12	1 hour per week or learning 5 topics per week
Catchup Math (Hot Math)	7-12	Not available

EdReady (The NROC Project)	7-12	Not applicable*
iReady (Curriculum Associates)	K-6, 7-12	45 minutes per week
Math XL (Pearson)	7-12	Not available
Reflex (Explore Learning)	K-6, 7-12	An algorithm that includes fluency gains and average number of logins per week.
ST Math (Mind Research)	K-6, 7-12	K-1: 60 minutes per week 2-8: 90 minutes per week
Think Through Math (Think Through Learning)	K-6, 7-12	Quarter 1 (Sept-Nov): 5+ Lessons Completed Quarter 2 (Dec-Feb): 10+ Lessons Completed Quarter 3 (Mar-May): 15+ Lessons Completed
Successmaker (Pearson)	K-6, 7-12	Not available**

Table 2. Fidelity of Implementation Benchmarks Set by Product Providers
Note. * "Not applicable" is noted for EdReady, a product where usage decisions are left to the teacher; therefore, there was no usage benchmark for recommended usage. ** "Not available" is noted when providers were not able to provide a benchmark in their data set.

To determine if the implementation of mathematics technology products had an effect on student interest and engagement in mathematics, we administered a validated mathematics engagement survey (Eccles & Wigfield, 1995), as a baseline and outcome measure. This math interest survey assesses several different constructs related to student' self-perceptions of abilities, perceived task values, and perceived task difficulties in relation to mathematics. Each of the survey prompts contained three factors of mathematics interest and engagement: intrinsic interest value, attainment value, and extrinsic utility value (Eccles & Wigfield, 1995; Eccles, 2009). Survey prompts addressing intrinsic interest value, targeted the enjoyment students' experience while engaging in mathematics (Eccles & Wigfield, 1995; Eccles, 2009). While survey prompts addressing attainment value, revealed the link between tasks and individuals' own identities and preferences (Eccles, 2009). Finally, survey prompts addressing extrinsic utility value addressed students' future plans in regard to mathematics (Eccles & Wigfield, 1995; Eccles, 2009).

In the K-6 section, there are seven quantitative survey prompts. Of these seven quantitative prompts, we focus on four that are representative of the overall survey. These four prompts align with our research questions regarding students' interest values, attainment values, and extrinsic utility values in mathematics. In the 7-12 section, there are 19 multiple-choice prompts. We include an analysis of six of these prompts that are representative of the overall survey. For a list of survey prompts, all available surveys were included in Appendix D.

Using the Qualtrics survey platform, we designed and administered pre and post-surveys to school districts. Survey links were distributed to LEAs who then disseminated the surveys to each of the K-12 teachers. A simpler version of the 7-12 survey was administered to the K-6 students to account for developmental differences (e.g., lower comprehension, literacy, etc). For example, Likert scale items were converted into a visual representation (i.e., a smiley face). Students could then use a slider to change the mouth from happy to neutral to sad along a 1 to 5 scale. We also included a Yes/No item about their perceptions of the usefulness of math for their future, and an item about the difficulty of math tasks that used a 0 to 10 dial visual.

Data Analysis

At the end of the school year, we reviewed the usage data provided by each vendor. During our usage data review process, we discovered that each vendor reported student's usage data in different ways. All vendors provided some student level data for the entire 2015-16 academic year. There were occasional anomalies in the data, which necessitated multiple consultations with vendors and the STEM Action Center (AC) to improve data quality. Clarification was also sought to understand the units of reporting and other definitions regarding the vendor data. Some of these anomalies and definitions include: usage data that contained multiple entries with the same username, which resulted in multiple usage and fidelity entries for the same student; the number of students appearing within the data set was greater than the number of licenses distributed to the LEA. In response to these data quality issues, efforts were made to reduce the effects of these anomalies through data cleaning. Not all vendors provided fidelity information due to restrictions in the design of their product.

At the end of the 2015-16 academic year, we analyzed the student pre and post-surveys. We analyzed the quantitative data by individual product. The qualitative data was analyzed for overall trends, and not by specific product. All responses were analyzed in the quantitative data, which included: K-6 pre-survey (N=10,484) and post-survey (N=15,974), 7-12 pre-survey (N=12,570) and post-survey (N=12,887). We then computed simple descriptive statistics including sample mean, standard deviation, and frequency distribution on all pre and post-survey responses. We compare quantitative results by product using these descriptive statistics.

Teacher Quantitative Methods

The Utah STEM Action Center (AC) sent each participating LEAs web links to pre and post-surveys, which were to be administered to teachers who participated in the math instructional software grant program. A coordinator at each LEA then distributed these links to participating teachers. The pre-survey was administered at the beginning of the school year, while the post-survey was administered toward the end of the school year. Completion of each survey was voluntary.

The pre and post-surveys were designed and teacher data was collected through the Qualtrics survey platform. These data were then analyzed for general trends and changes in teachers' perceptions toward the math software. This analysis was then summarized into various tables and graphs to be included in this report.

Student and Teacher Qualitative Methods

Methodology: Open Coding

The methodology used for analyzing these responses is commonly known as "open coding" (Corbin & Strauss, 1990). This approach consists of dividing each response into a number of sub-comments and then assigning each sub-comment to a category. For instance, if a student's response to a prompt was "I think the software is entertaining but it is often glitchy at times" two different comments would be coded, one for "I think the software is entertaining" and another for "it often glitches at times." Each comment would then be put in its own separate category alongside similar comments. At the end of the coding process, the number in each category is counted and its relative frequency compared to other categories.

The advantage of this approach is that it allows for much more diverse and detailed responses compared to the standard multiple choice prompts. It also has the potential to alert researchers to blind spots in their knowledge, given that respondents are free to respond in whatever way they deem valuable. This quality makes open coding an excellent discovery tool.

The disadvantage of open coding is that, at times, it can be ambiguous as to which category a particular comment belongs. This can force the researcher to a make a value-judgement regarding these comments. For example, consider the comment "It's alright." One researcher might choose to code the comment as neutral, while another might decide that it belongs to the positive category. The decision to create a category is highly discretionary as well, which creates the potential for different researchers to have different views on the appropriate number and type of categories needed to properly classify all of the responses.

A pre and post-survey was administered to students and teachers. Each open response prompt from these surveys was coded using the method described above. Frequencies of these responses were then summarized in tables. Included in these tables, are representative comments for each category that was coded throughout the process.

Student Results

Results of K-12 Student Usage and fidelity

This section will answer the first two research prompts, namely:

- Did the number of distributed licenses match the quantities requested by individual LEAs?
- To what extent do students use the software products to the level recommended by the vendor?

At the end of the 2015-16 academic year, we collected cumulative usage data for each math software product. There were 183,109 licenses requested by 93 LEAs representing 556 schools. Of the requested licenses, 166,993 were distributed, giving an approximate 91% license fulfillment rate. High demand and limited grant funds prohibited the STEM AC from satisfying 100% of the licenses requested by LEAs.' At times, some LEAs ended up with a greater number of licenses than requested. This occurred due to reallocation of licenses after the initial distribution. Thus, efforts were made to meet the gap between requested and awarded licenses by reallocating any unused product.

Although participants did not always use the licenses awarded, there was a high percentage of use overall. There were 131,602 students who used the software product out of 166,993 who were awarded. That is, 79% of students had at least some software usage. Although 21% of students did not have any software use, this may be attributed to several factors including: the teacher's discretion on whether or not to incorporate the product in their classroom, a desire for more training, lack of technology accessibility, or other technical problems.

Since the Utah State Board of Education had not reviewed the math software products for alignment to state math standards, teachers were to use the software only as a supplement, and not to replace classroom instruction. In addition, many of the software vendors performed their own internal evaluations to determine an optimal level of use, or fidelity benchmark. This fidelity level is consistent with the requirement that the software be used for supplemental instruction. There were a total of 63,832 students who used the product with fidelity, or 49% of students who had greater than 1 minute of usage. As with usage, those who did not meet fidelity, may not have done so due to resource constraints (e.g., insufficient computer access). Although it was recommended that the products were used as a supplement, there was evidence that these products were used in other ways including credit recovery and homework. As a result, actual usage is sometimes greater than recommended usage. In the usage section below, we provided summaries of license distribution and usage for the nine math products that are currently being funded by the Utah STEM Action Center. These include: ALEKS, Catchup Math, EdReady, iReady, Math XL, Reflex Math, Think Through Math (TTM), and Successmaker.

Usage and fidelity

ALEKS

Based on cumulative usage data collected in June 2016, there were 79,596 students given an ALEKS license (as shown in Table 3), and 79,585 students had evidence of time spent in the program. Average usage was about 127 minutes per month and, among these users, 38,634 students, or 49 percent, met the provider recommended usage.

Total Licenses Requested	98,685

Total Number of Awarded Districts/ Charters	27
Total Number of Awarded Schools	273
Total Enrolled Students	79,596
Total Participating Students (> 0 mins. of use)	79,585
Total Students Meeting Fidelity	38,634
Average Minutes Usage Per Month for All Students	126.85
Percentage of Users who used ALEKS	99
Percentage of Users who met Fidelity	49

Table 3. Summary of License Distribution and Usage for ALEKS

Catchup Math

Based on cumulative usage data collected in June, 2016 (as shown in Table 4), 381 students were given a Catchup Math license, but only 258 students had evidence of time spent in the program, which is about 68 percent of the licenses assigned. Usage time is on average 9 minutes per months. Among users, 56 students, or 15 percent, met the provider's recommended usage benchmark, which is about 22 percent.

Total Licenses Requested	**502**
Total Number of Awarded Districts/ Charters	3
Total Number of Awarded Schools	3
Total Enrolled Students	381
Total Participating Students (> 0 mins. of use)	258
Total Students Meeting Fidelity	56
Average Minutes Used Per Month for All Students	9.20
Percentage of Users who used Catchup Math	68
Percentage of Users who met Fidelity	22

Table 4. Summary of License Distribution and Usage for Catchup Math

EdReady

Based on cumulative usage data collected in June 2016 (as shown in Table 5), 1,286 students were given an EdReady license. Average usage time was approximately 67 minutes per month. Among these users, 183 students, or 14 percent, met the provider's recommended usage.

Total Licenses Requested	305
Total Number of Awarded Districts/ Charters	8
Total Number of Awarded Schools	14
Total Enrolled Students	1,286
Total Participating Students (> 0 mins. of use)	1,285
Total Students Meeting Fidelity	183
Average Minutes Used Per Month for All Students	67
Percentage of Users who used EdReady	99
Percentage of Users who met Fidelity	14

Table 5. Summary of License Distribution and Usage for EdReady

iReady

Based on the cumulative usage data collected in June 2016 (as shown in Table 6), there were 21,333 students given an iReady license. Average usage time was approximately 86 minutes per month. Among these users, 4,056 students, or 19 percent, met the provider's recommended usage.

Total Licenses Requested	24,539
Total Number of Awarded Districts/ Charters	15
Total Number of Awarded Schools	66
Total Enrolled Students	21,333
Total Participating Students (> 0 mins. of use)	21,333
Total Students Meeting Fidelity	4,056
Average Minutes Used Per Month for All Students	85.66
Percentage of Users who used iReady	100
Percentage of Users who met Fidelity	19

Table 6. Summary of License Distribution and Usage for iReady

Math XL

Based on the cumulative usage data collected in June 2016 (as shown in Table 7), there were 5,526 students given a Math XL license. Approximately 5,377 students had evidence of time spent in the program. Average usage time was approximately 3 hours per month. No fidelity data was provided by the vendor. Thus, the number of students meeting the vendors recommended level of usage is not reported.

Total Licenses Requested	**4,223**
Total Number of Awarded Districts/ Charters	8
Total Number of Awarded Schools	12
Total Enrolled Students	5,526
Total Participating Students (> 0 mins. of use)	5,377
Total Students Meeting Fidelity	No fidelity data was provided
Average Minutes Used Per Month for All Students	170
Percentage of Users who used Math XL	97
Percentage of Users who met Fidelity	No fidelity data was provided

Table 7. Summary of License Distribution and Usage for Math XL

Reflex

Based on cumulative usage collected in June 2016 (as shown in Table 8), 4,688 students were given a Reflex Math license. Usage time averages 2.65 minutes per months. Of these users, 2,890 students met the provider's recommended level of usage. Thus, approximately 62 percent of students met the fidelity level.

Total Licenses Requested	**2,568**
Total Number of Awarded Districts/ Charters	5
Total Number of Awarded Schools	17
Total Enrolled Students	4,688
Total Participating Students (> 0 Days of use)	4,688
Total Students Meeting Fidelity	2,890
Average Days Used Per Month for All Students	2.65
Percentage of Users who used Reflex	100
Percentage of Users who met Fidelity	62

Table 8. Summary of License Distribution and Usage for Reflex

ST Math

Based on the cumulative usage data collected in June 2016 (as shown in Table 9), there were 31,414 students given an ST Math license. Usage data, showing the number of minutes each student used the software was not provided by the vendor. Thus, it is not reported here. Of those who used the product, 9,294 students, or 30 percent, met the provider's recommended level of usage.

Total Licenses Requested	**30,824**
Total Number of Awarded Districts/ Charters	12
Total Number of Awarded Schools	78
Total Enrolled Students	31,414
Total Participating Students (> 0 mins. of use)	No usage data was provided
Total Students Meeting Fidelity	9,294
Average Minutes Used Per Month for All Students	No usage data was provided
Percentage of Users who used ST Math	N/A
Percentage of Users who met Fidelity	N/A

Table 9. Summary of License Distribution and Usage for ST Math

Note. We could not calculate percentage of users who used ST math and users who met fidelity because total participating students (>0 mins. Of use) was not provided.

Think Through Math (TTM)

Based on cumulative usage collected in June 2016 (as shown in Table 10), 27,583 students were given a Think Through Math license. Of those, 23,741 students had evidence of time spent using the program. Usage time averaged 3 hours per month. Among these users, 8,719 students, or 32 percent, met the provider's recommended level of usage.

Total Licenses Requested	**25,522**
Total Number of Awarded Districts/ Charters	13
Total Number of Awarded Schools	89
Total Enrolled Students	27,583
Total Participating Students (> 0 mins. of use)	23,741
Total Students Meeting Fidelity	8,719
Average Minutes Used Per Month for All Students	162.53
Percentage of Users who used TTM	86
Percentage of Users who met Fidelity	37

Table 10. Summary of License Distribution and Usage for TTM

Successmaker

Based on cumulative usage collected in June 2016 (as shown in Table 11), 712 students were given a Successmaker license. Average usage time was approximately 1.5 hours per month. Among these users, 708 students met the provider's recommended level of usage. This is approximately 99 percent of students.

Total Licenses Requested	164
Total Number of Awarded Districts/ Charters	2
Total Number of Awarded Schools	4
Total Enrolled Students	712
Total Participating Students (> 0 mins. of use)	712
Total Students Meeting Fidelity	708
Average Minutes Used Per Month for All Students	82.29
Percentage of Users who used Successmaker	100
Percentage of Users who met Fidelity	99

Table 11. Summary of License Distribution and Usage for Successmaker

Usage Discussion and Summary

From the usage tables above, the total students enrolled who used EdReady, Math XL, Reflex, ST Math, Think Through Math, and Successmaker were larger than the actual licenses that the school districts requested. As previously noted, there was a reallocation of licenses between LEAs, which explains this discrepancy. This process was designed to decrease the number of unused licenses during the 2015-16 academic year.

There are also variations in the average number of minutes used per month. For example, students who used ALEKS had an average of 127 minutes per month, while students who used Math XL showed an average of 170 minutes per month. Both of these values are very close to the recommended 45 minutes per week for math instructional software, with ALEKS users having an average of 31.8 minutes per week, and Math XL users having an average of 42.5 minutes per week. We note that usage data is provided by the software vendors.

The definition of recommended level of use, or fidelity, varied by vendor. There were also large variations in the reported percentage of students who met fidelity, ranging from a low of 14% to a high of 99% of participating students. Differences in the definition of fidelity make comparing these values difficult. In addition, ST Math and Math XL did not provide fidelity data. Thus, all math software products cannot be compared pairwise, however, we note that of those products who did provide these data, 48% of students met the fidelity level.

To be discussed later, teacher survey results indicated that many teachers experience barriers to software use. These barriers included: technology accessibility, internet browser issues, and a desire for further product training. These barriers may also have affected the average fidelity level for participating students. Thus, we recommend determining a way to make technology more accessible to teachers. We also recommend that training be more frequent and accessible.

Student Survey Results

There are six different math products that were designed for K-6 students (i.e., ALEKS, iReady, Reflex, ST Math, TTM, and Successmaker) and nine products for the 7-12 students (i.e., ALEKS, Catchup Math, EdReady, iReady, Math XL, Reflex, ST Math, TTM, and Successmaker). We collected 16,521 students K-6 and 16,737 students 7-12 pre and post-survey responses. We used this data to analyze students' perceptions about their interest in math. We also analyze students' opinions about the math technology products.

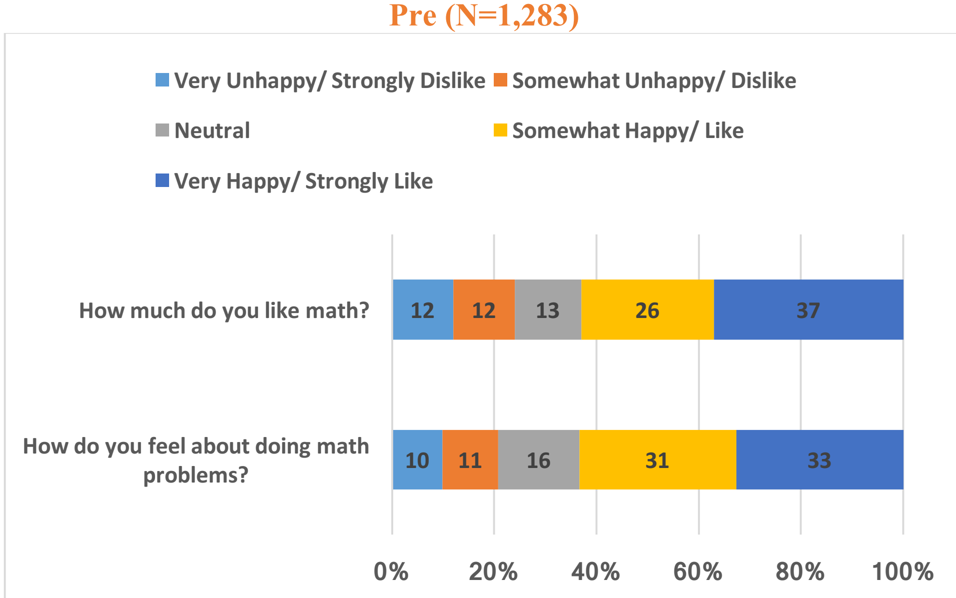
The K-6 survey contained seven quantitative prompts, while the 7-12 survey contained 19 quantitative prompts. Student attitudes toward math were consistent throughout the surveys. Since many of the prompts seemed redundant, we selected four representative prompts for the K-6 and six prompts for the 7-12, which are presented in this report.

Student K-6 Surveys

ALEKS

The first and second K-6 survey prompts asked students to describe "how much do you like math" and "how do they feel about doing math problems." Overall, students' perceptions about math remained nearly constant, as seen in Figure 2. Throughout the academic year, there was a small decrease, 37% to 33%, in the number of students who selected "very happy" to describe their perceptions toward math. There was also a small increase, 31% to 35%, in the number of students who selected "somewhat happy" to describe their attitudes toward doing math problems.

Pre (N=1,283)



Post (N=2,823)

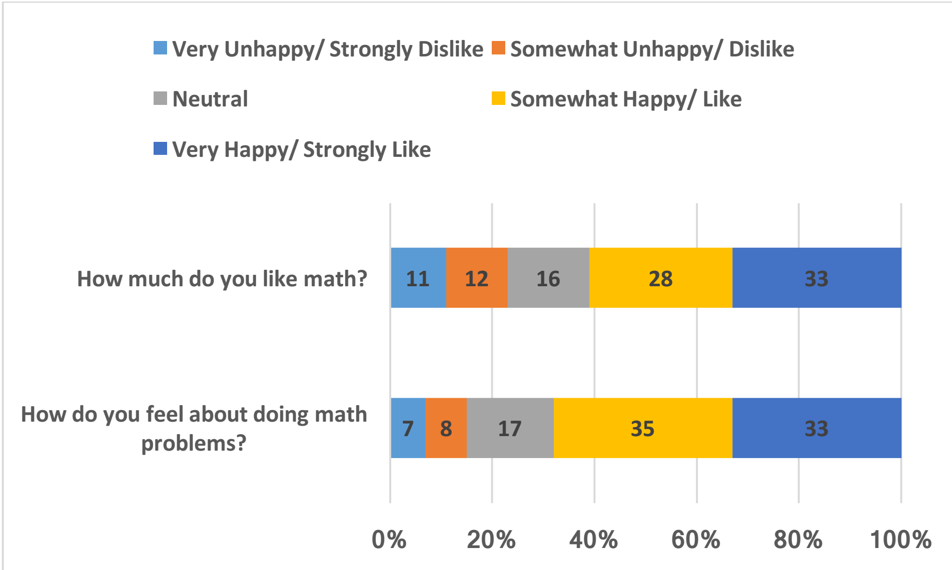
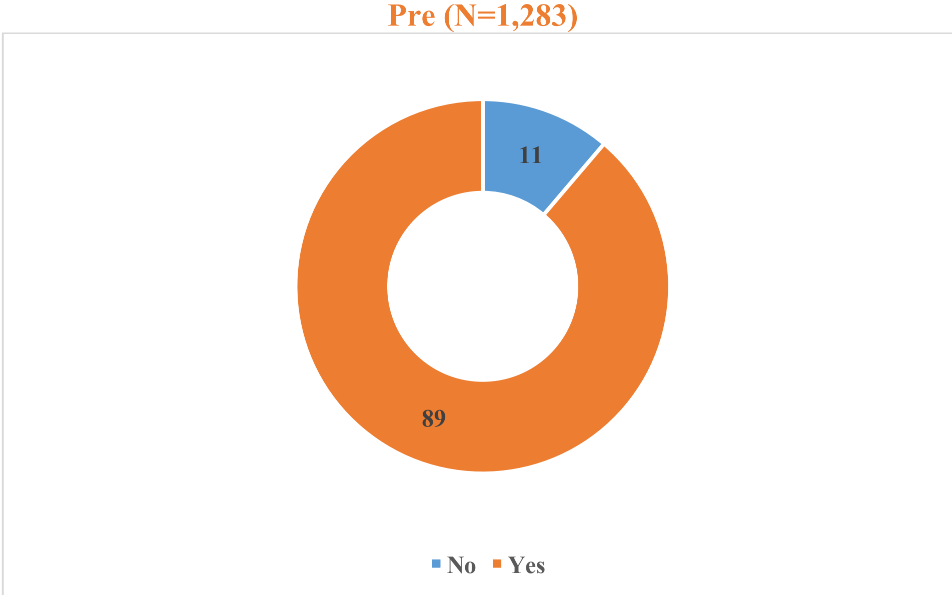


Figure 2. ALEKS: Students perceptions

Students were asked whether they think they will need math when they get older and get a job. Overall, the pre and post-survey indicated similar results. Most K-6 students who used ALEKS think that they need math to get a job (see Figure 3).

Pre (N=1,283)



Post (N=2,823)

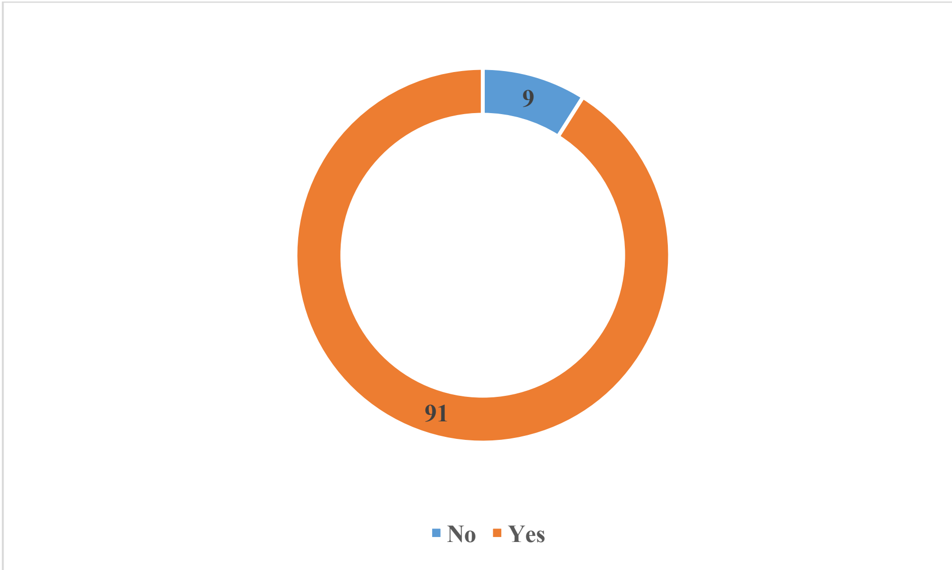
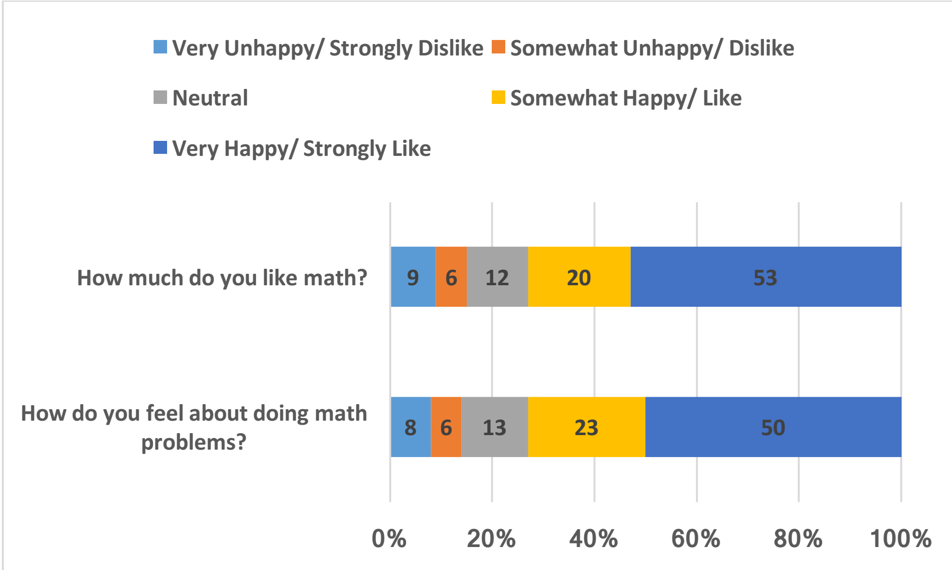


Figure 3. ALEKS: *Will you need math when you get older and get a job?*

iReady

The first and second K-6 survey prompts asked students to describe "how much do you like math" and "how do they feel about doing math problems." Overall, students' perceptions about math remained nearly constant, as seen in Figure 4. There was a decrease between students who felt happy about math. In particular, 53% responded that they felt "very happy" at the beginning of the year, compared to 44% at the end of the year. There was also a decrease, 50% to 40%, in student perceptions about how they felt when doing math problems. Although these two prompts had decreases in the "very happy" category, the overall trend showed that students had positive perceptions about math throughout the academic year.

Pre (N=3,049)



Post (N=2,814)

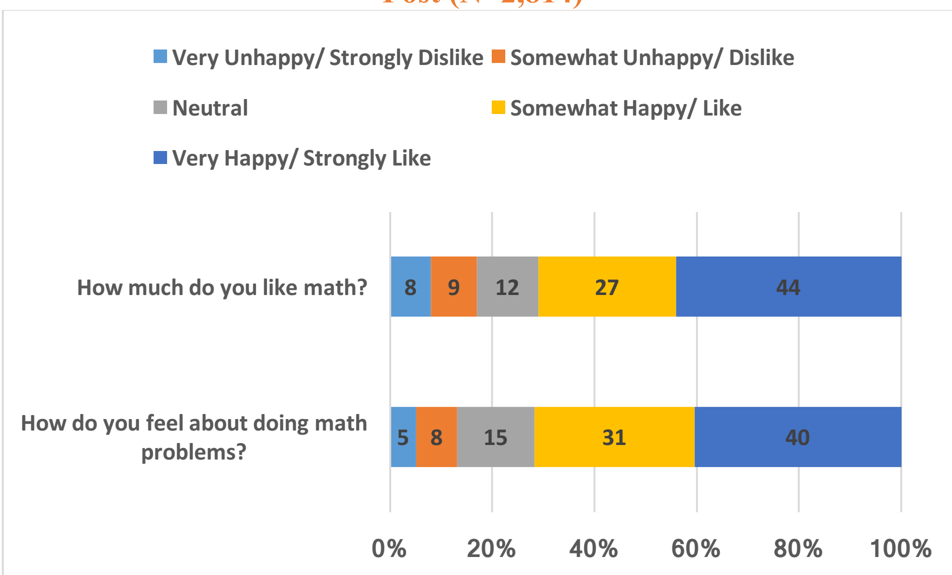
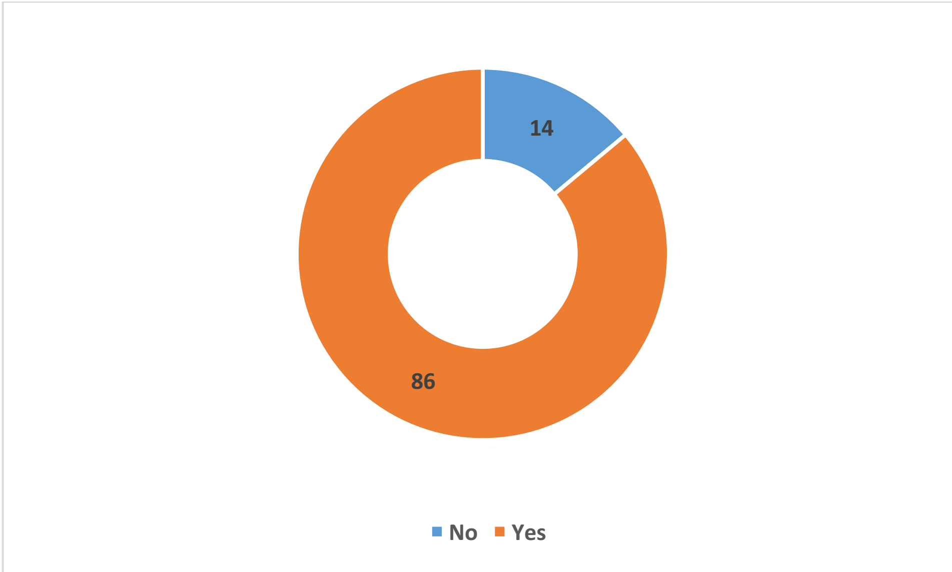


Figure 4. iReady Students perceptions

Students were asked whether they think they will need math when they get older and get a job. Overall, students who used iReady indicated that they think they will need math when they "get older and get a job." (see Figure 5). In addition, more students felt that this was true by the end of the school year, with an 8 percentage point increase in those who think they will need math when they get a job.

Pre (N=3,049)



Post (N=2,814)

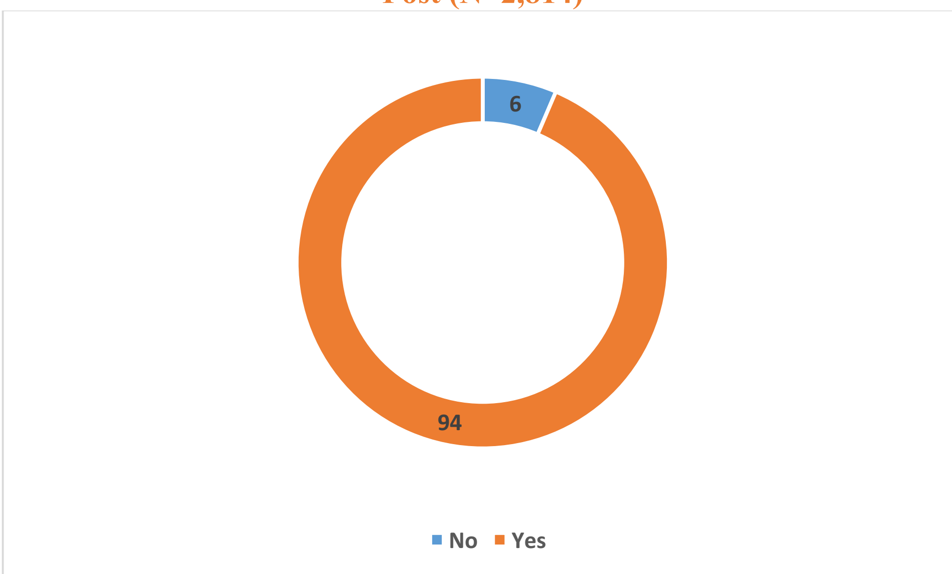


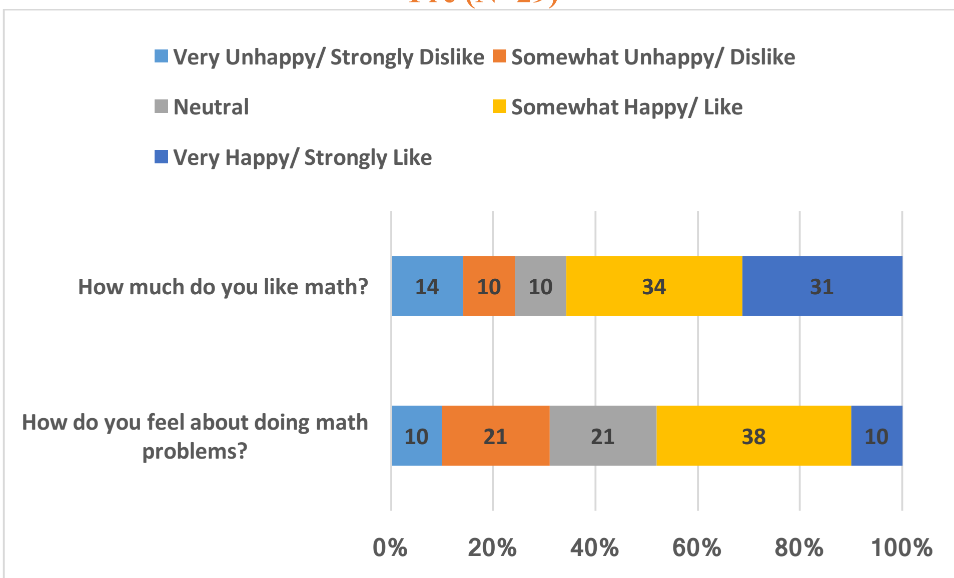
Figure 5. iReady: Will you need math when you get older and get a job?

Reflex

The first and second K-6 survey prompts asked students to describe "how much do you like math" and "how do they feel about doing math problems." Overall, students' perceptions about math remained nearly constant. As seen in Figure 6, there were large increases in both how much students liked math, a change from 31% to 40% in the "very happy" category, and how they felt when doing math problems, a change from 10% to 37% in the "very happy" category.

There was also a change in sample size from pre to post-survey (N=29 to N=314), which may account for the large increase in student perceptions.

Pre (N=29)



Post (N=314)

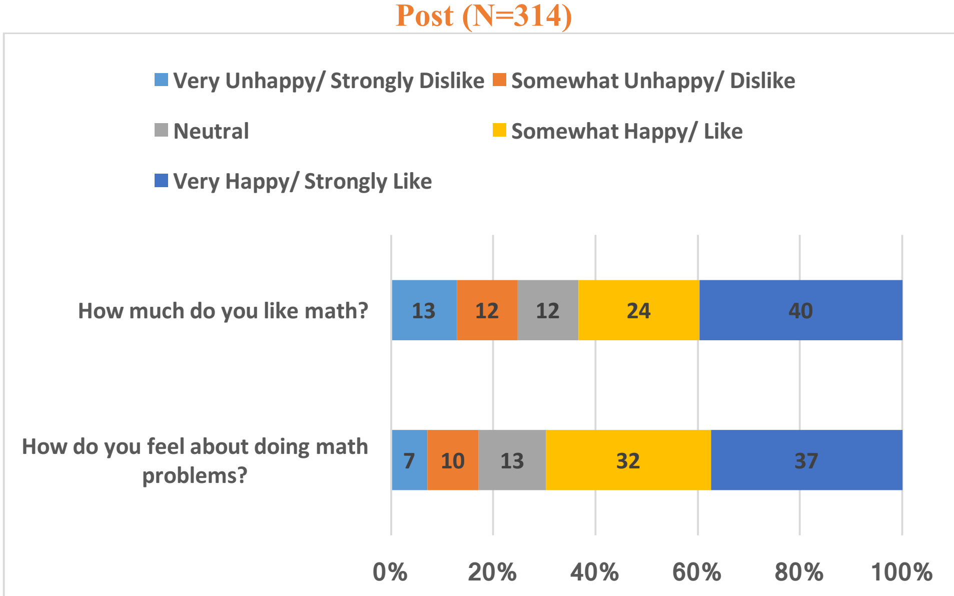
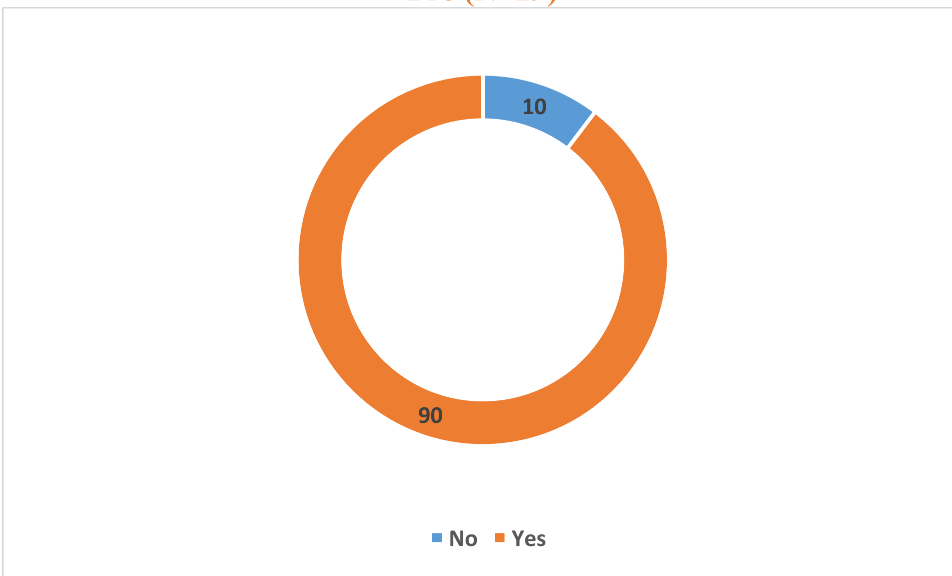


Figure 6. Reflex Students perceptions

Students were also asked whether they think they will need math when they get older and get a job. There was a 1 percentage point increase in students who though they would need math when they got a job (see Figure 7). The overall results are consistent with the other products in that students overwhelmingly indicated that they thought they would need math in future careers.

Pre (N=29)



Post (N=314)

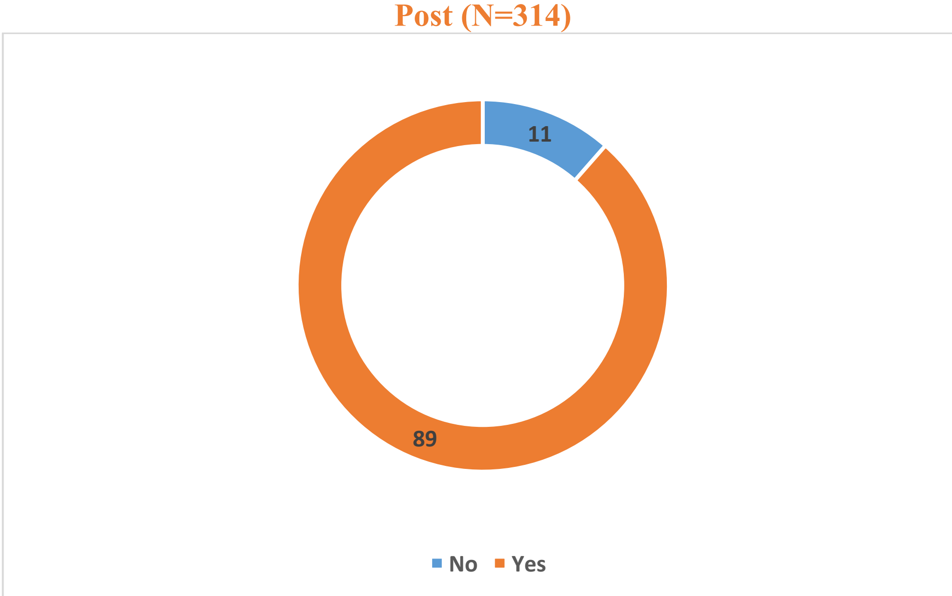
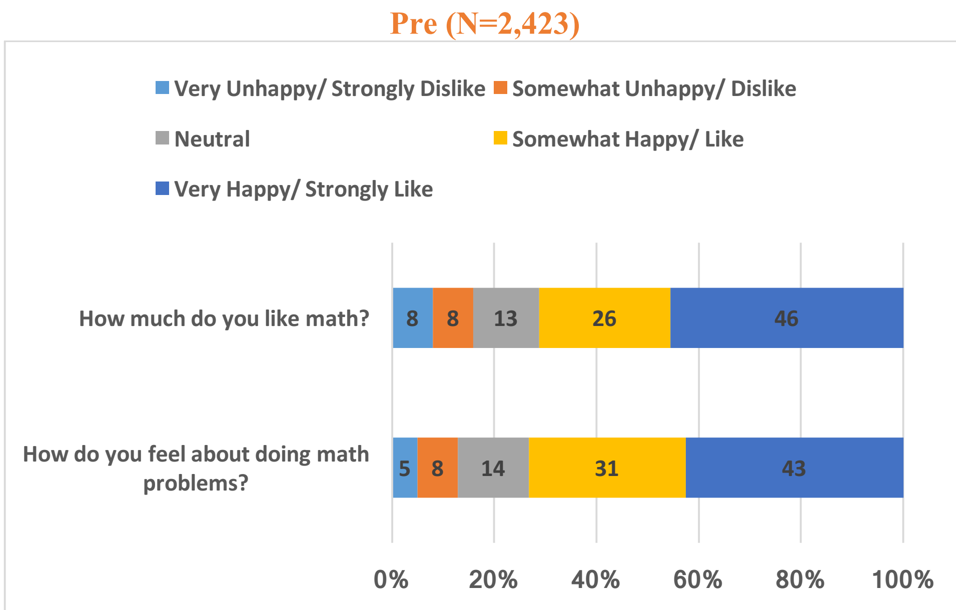


Figure 7. Reflex: Will you need math when you get older and get a job?

ST Math

The first and second K-6 survey prompts asked students to describe "how much do you like math" and "how do they feel about doing math problems." As seen in Figure 8, overall students' perceptions about math remained nearly constant. Although there were small overall decreases in student perceptions toward math, most students maintained positive attitudes towards this subject.



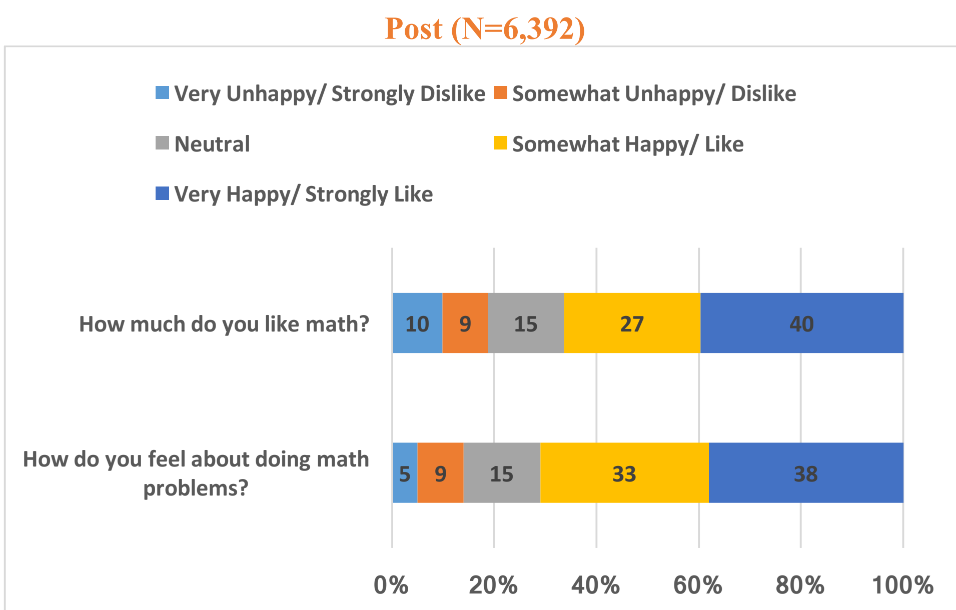
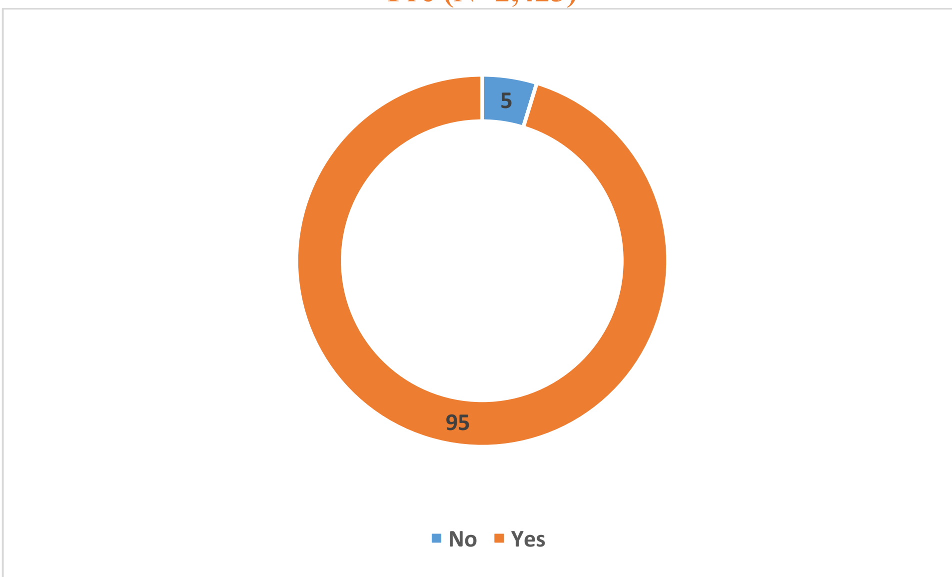


Figure 8. ST Math: Students' perceptions

Students were asked whether they think they will "need math when they get older and get a job." Overall, the pre and post-survey results indicated the vast majority of students believe they will need math when they get a job (see Figure 9).

Pre (N=2,423)



Post (N=6,392)

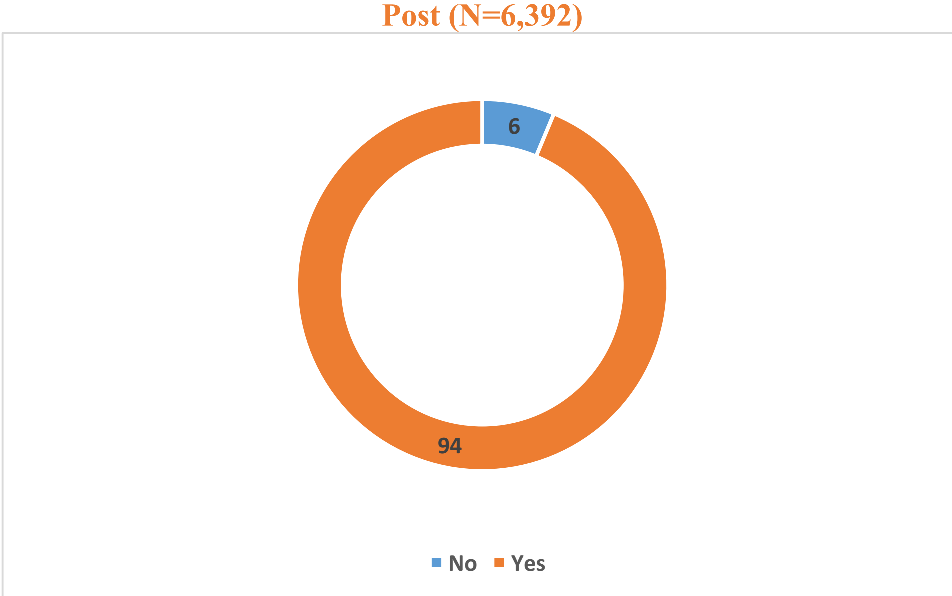
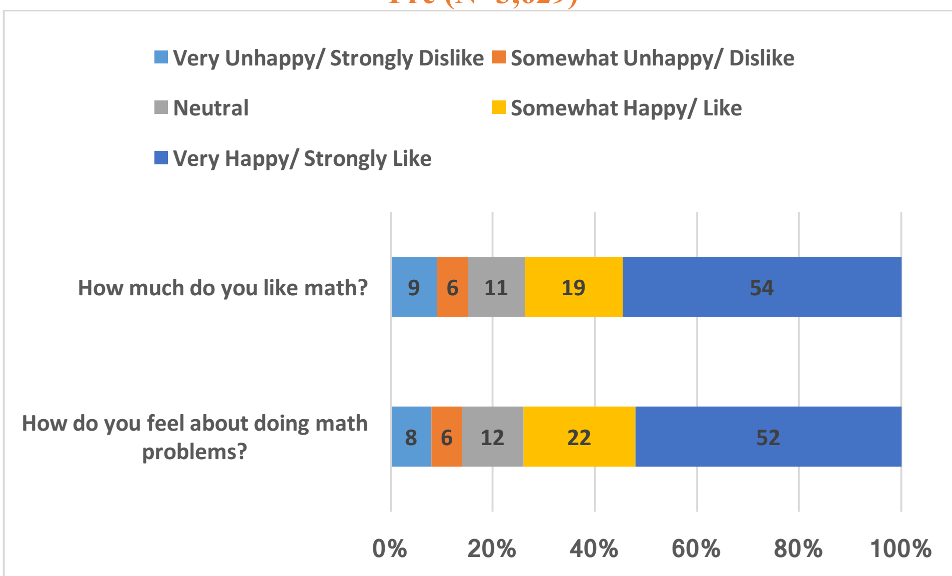


Figure 9. ST Math: Will you need math when you get older and get a job?

Think Through Math (TTM)

The first and second K-6 survey prompts asked students to describe "how much do you like math" and "how do they feel about doing math problems." Overall, students' perceptions about math remained nearly constant, as seen in Figure 10. Although, there were overall decreases in student "happiness" when comparing the pre-survey to the post-survey results, most students remained positive about math and doing math problems.

Pre (N=3,629)



Post (N=3,101)

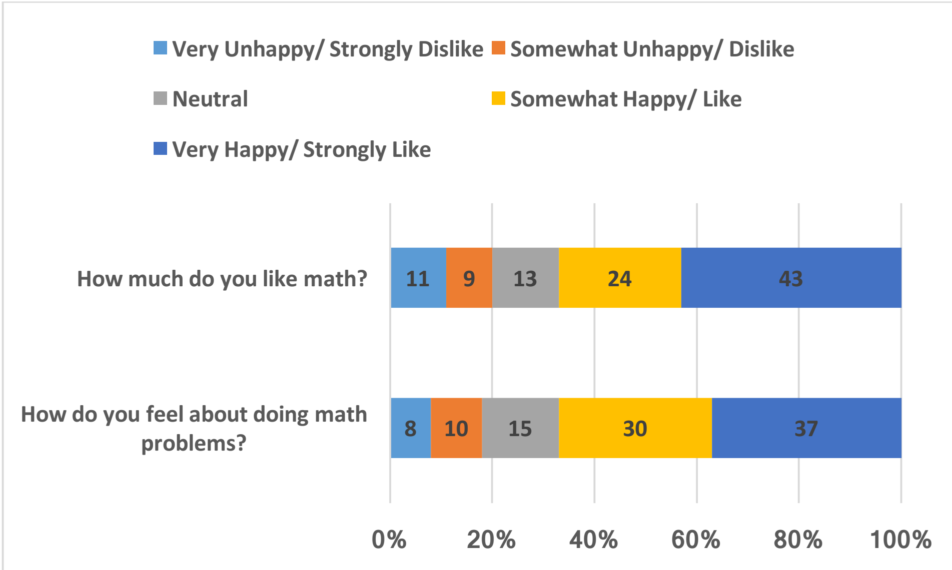
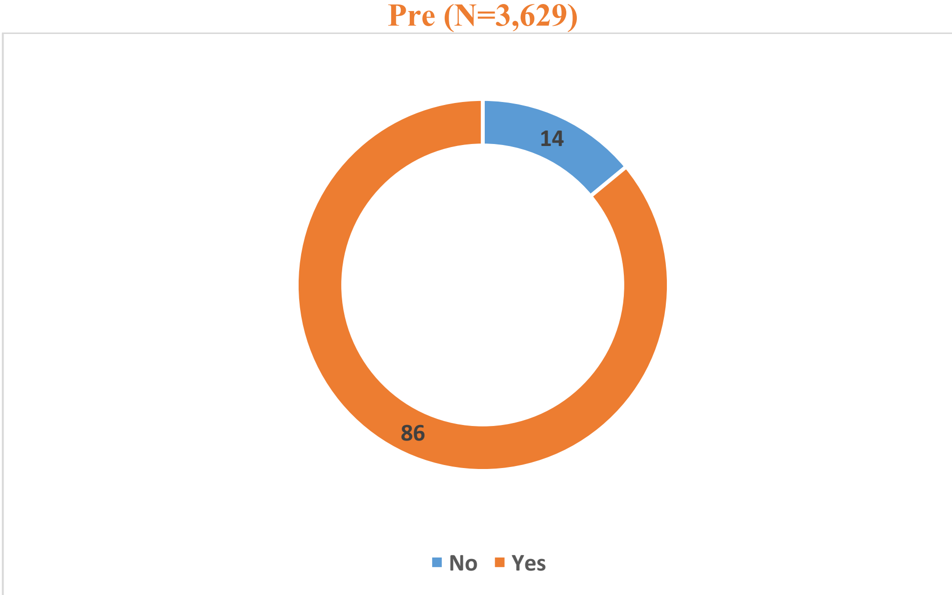


Figure 10. Think Through Math Students perceptions

Students were also asked whether they think they will need math when they "get older and get a job." The overall majority of students indicated that they think they will need math in their future career (see Figure 11).

Pre (N=3,629)



Post (N=3,101)

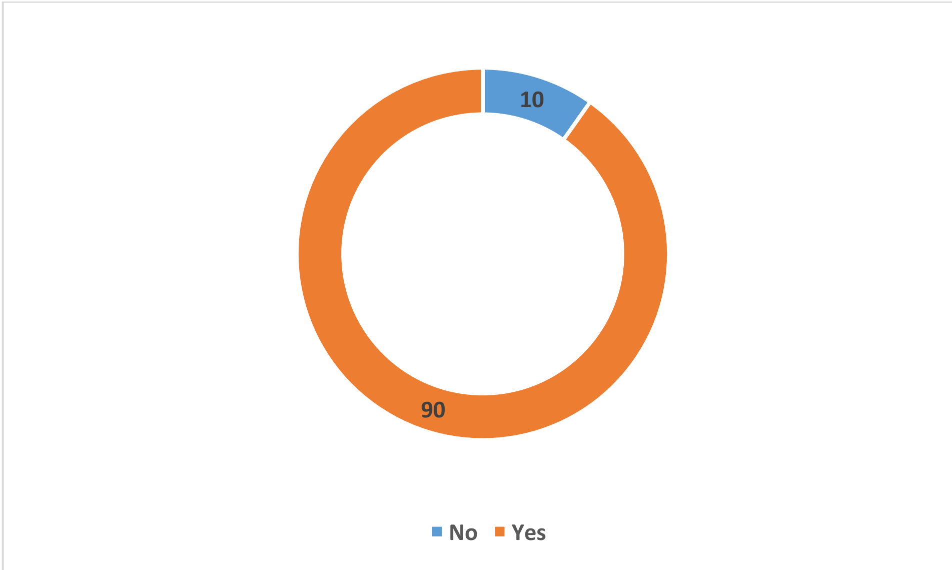
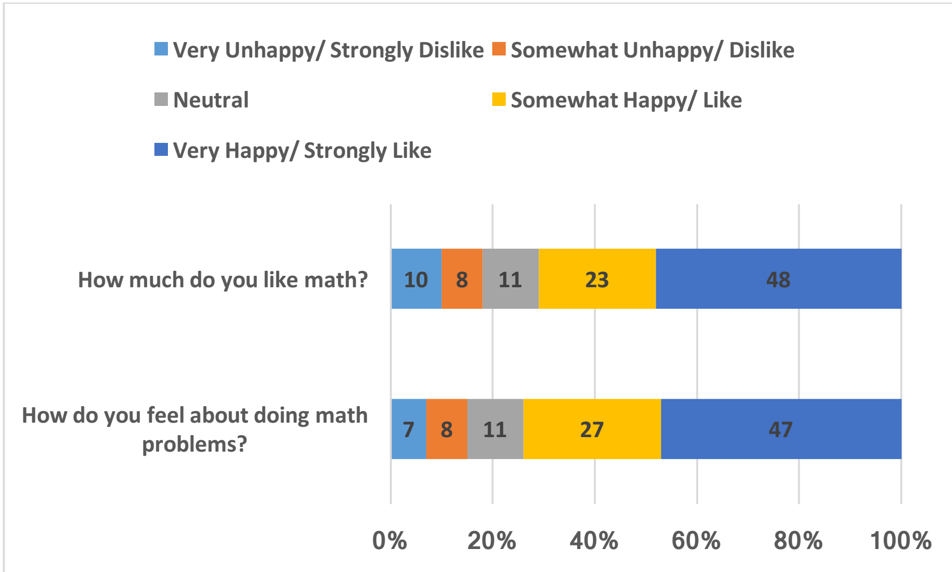


Figure 11. Think Through Math: Will you need math when you get older and get a job?

Successmaker

The first and second K-6 survey prompts asked students to describe “how much do you like math” and “how do they feel about doing math problems.” As seen in Figure 12, overall students’ perceptions about math remained nearly constant. Although there were decreases in overall student “happiness,” the majority of students indicated that they were positive about math and doing math problems. In addition, there were large changes in response size between pre and post-surveys that may account for this variation (N=29 to N=314).

Pre (N=29)



Post (N=314)

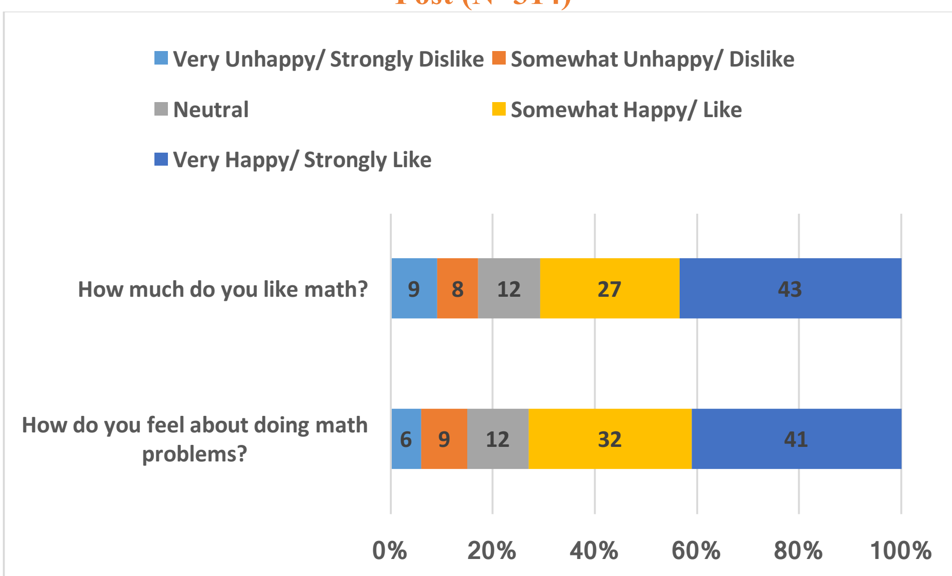
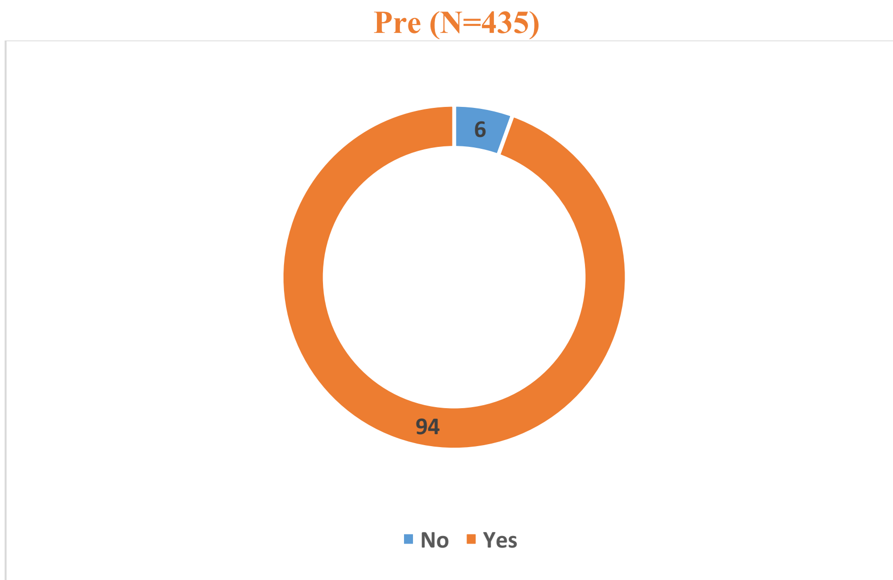


Figure 12. Successmaker Students perceptions

Students were asked whether they think they will need math when they get older and get a job. The vast majority of students indicated that they thought they would need math in their future occupation. (see Figure 13).



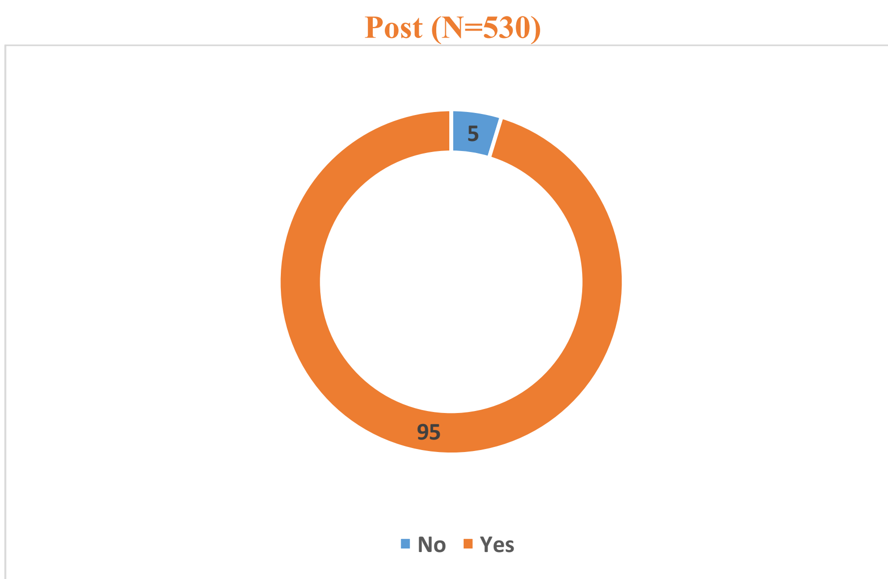
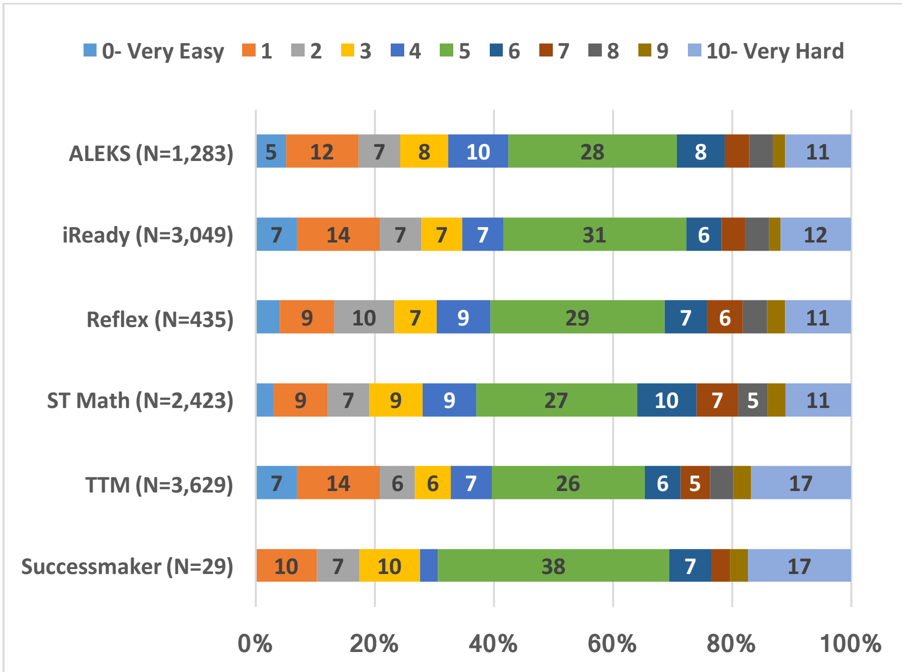


Figure 13. Successmaker: Will you need math when you get older and get a job?

The distribution of responses to the question "How is math for you compared to other subjects you learn in school" was very similar in both the pre and the post-surveys. The responses were easily within one standard deviation from both the pre and post-surveys, as seen in Table 12. Although, the responses were more or less normally distributed, and there was little change from pre to post-survey. Reflex Math had a gain of 0.7 percentage points in the mean response. This was the only notable change over the academic year.

Pre



Post

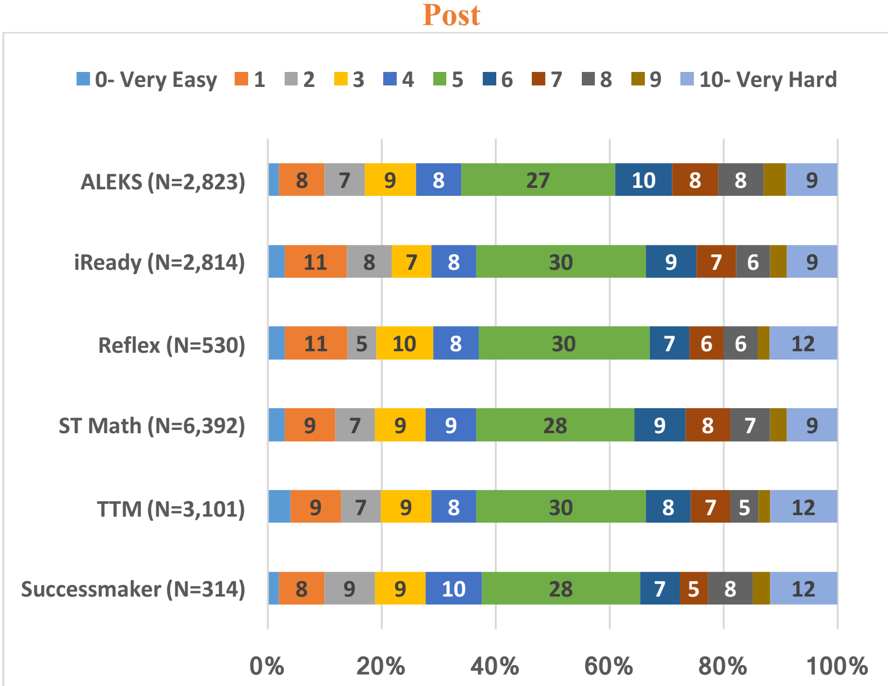


Figure 14. How is math for you compared to other subjects you learn in school? Labels have been excluded for values less than 5%.

Product	Sample Size	Mean	(*SD*)
ALEKS	Pre (N=1,283)	4.72	-2.8
	Post (N=2,823)	5.19	-2.61
iReady	Pre (N=3,049)	4.64	-2.97
	Post (N=2,814)	4.94	-2.63
Reflex	Pre (N=29)	5.28	-2.83
	Post (N=314)	5.17	-2.71
ST Math	Pre (N=2,423)	5.06	-2.73
	Post (N=6,392)	5.04	-2.61
TTM	Pre (N=3,629)	4.98	-3.19
	Post (N=3,101)	5.06	-2.77
Successmaker	Pre (N=435)	4.92	-2.77
	Post (N=530)	4.99	-2.77

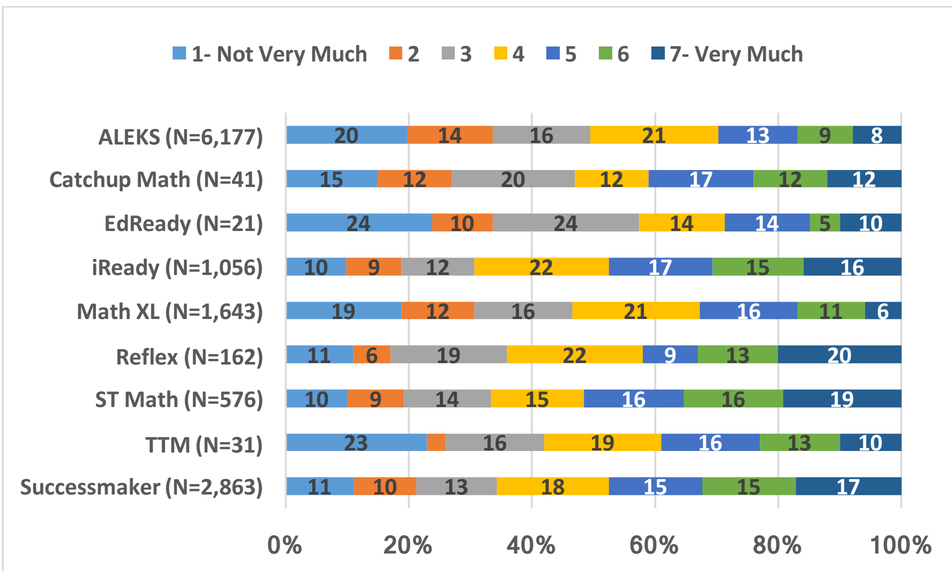
Table 12. How is math for you compared to other subjects you learn in school?

Student 7-12 Surveys

Out of the 19 quantitative prompts in the 7-12 math interest surveys, six representative prompts were selected for this report. For aesthetic purposes, numeric labels were excluded from response rates of less than 5% on each graph. The 7-12 survey followed a theme similar to that of the K-6 survey, asking students about their perceptions of math.

The first 7-12 math interest survey prompt asked students how much they "like doing math." There is some stability in response type from pre-survey to post. On a 7-point scale, the most notable changes include: an increase of 0.9 points for users of Math XL; a 1.33-point decrease for users of Reflex Math; and a 0.59-point decrease for EdReady users (see Table 13). The large decrease seen in Reflex Math may be due to changes in response size (N=162 to N=15). The most notable positive change over the academic year was for Math XL users, who responded that they like doing math after using the product.

Pre



Post

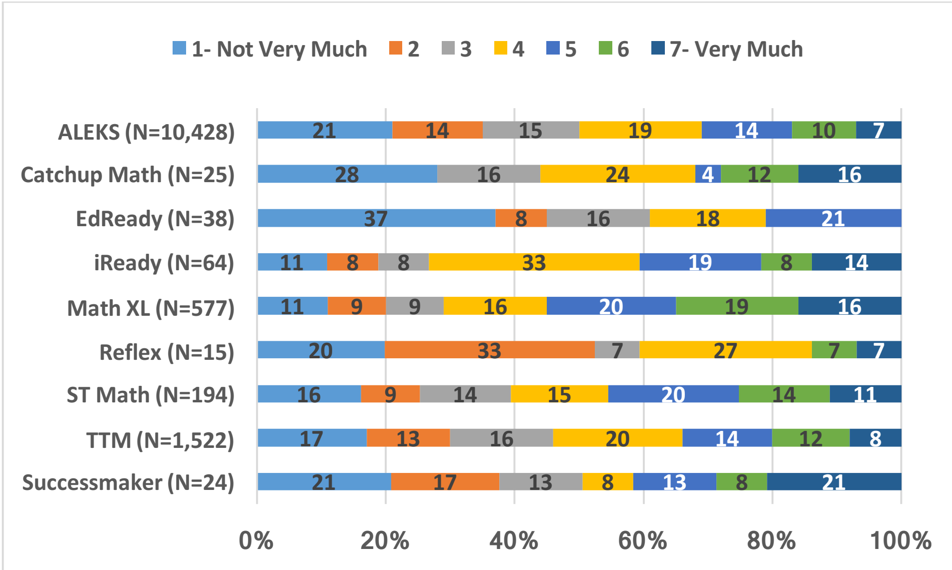


Figure 15. How much do you like doing math?

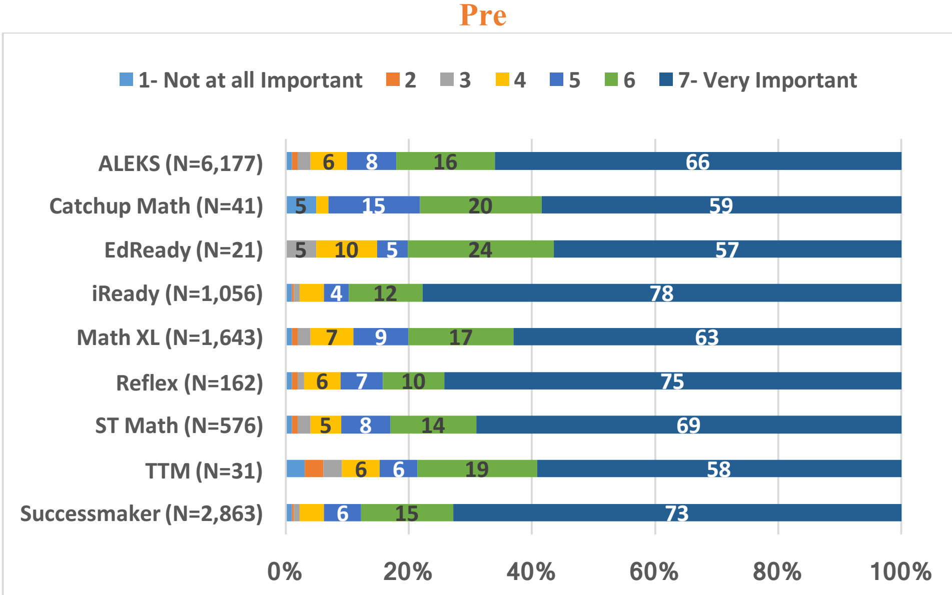
Product	Sample Size	Mean	(*SD*)
ALEKS	Pre (N=6,177)	3.51	-1.86
	Post (N=10,428)	3.49	-1.86
Catchup Math	Pre (N=41)	3.9	-1.96
	Post (N=25)	3.76	-2.18
EdReady	Pre (N=1,643)	3.57	-1.8
	Post (N=577)	4.47	-1.91
iReady	Pre (N=1,056)	4.37	-1.85
	Post (N=64)	4.2	-1.77
Math XL	Pre (N=1,643)	3.57	-1.8
	Post (N=577)	4.47	-1.91
Reflex	Pre (N=162)	4.33	-1.94
	Post (N=15)	3	-1.81
ST Math	Pre (N=576)	4.43	-1.94
	Post (N=194)	4.01	-1.95
TTM	Pre (N=31)	3.81	-1.99

	Post (N=1,522)	3.68	-1.85
Successmaker	Pre (N=2,863)	4.31	-1.93
	Post (N=24)	3.83	-2.28

Table 13. How much do you like doing math?

The second prompt asked students "how important is it for you to get good grades in math?" Immediately noticeable from pre and post-survey responses in Figure 16, the majority of students responded that they thought a good grade in math was "very important." Although there was very little variation in both the pre and the post-survey, the post-survey had slightly more variation. On a 7-point scale, three notable changes were: a 1.09-point decrease for iReady users; a 0.8-point decrease for Reflex Math users; and Successmaker, which had a 0.4-point decrease (See Table 14). Although these products each had a decrease, the overall percent of students within the "very important" category remained very high. In addition, these changes may be attributed to small response size or large changes in response size.

Pre



Post

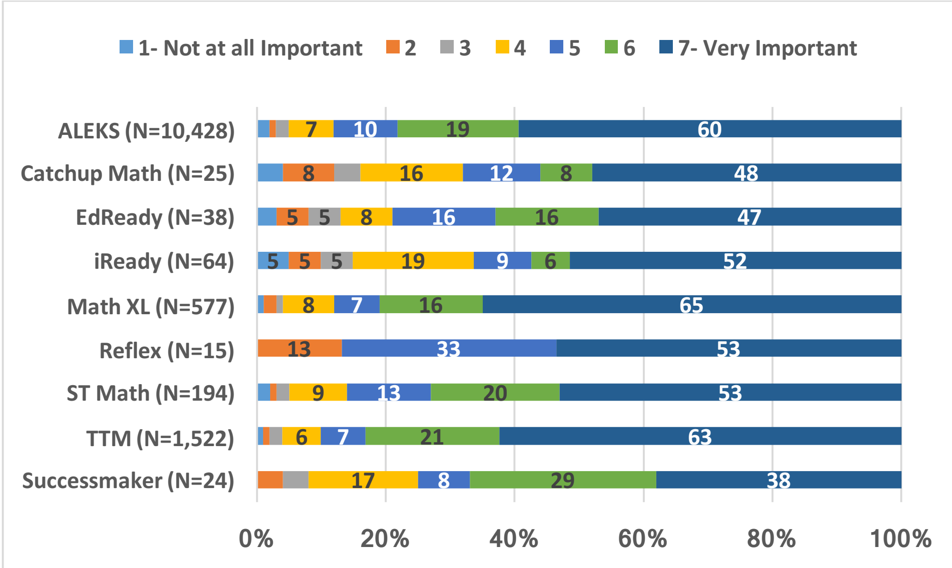


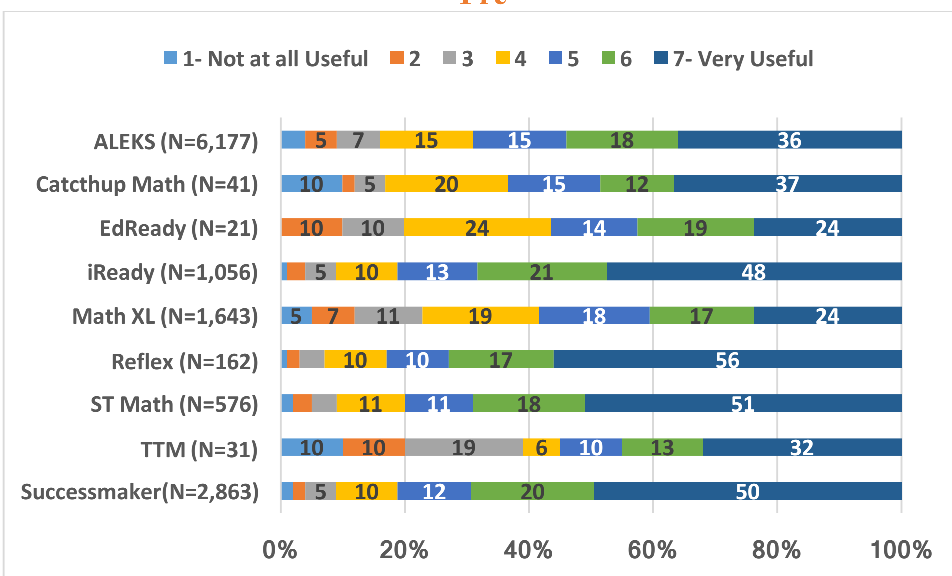
Figure 16. How important is it to you to get good grades in math? Labels have been excluded for values less than 5%.

Product	Sample Size	Mean	(*SD*)
ALEKS	Pre (N=6,177)	6.33	-1.17
	Post (N=10,428)	6.18	-1.29
Catchup Math	Pre (N=41)	6.15	-1.44
	Post (N=25)	5.4	-1.91
EdReady	Pre (N=1,643)	6.19	-1.21
	Post (N=577)	5.66	-1.7
iReady	Pre (N=1,056)	6.57	-0.98
	Post (N=64)	5.48	-1.87
Math XL	Pre (N=1,643)	6.25	-1.25
	Post (N=577)	6.29	-1.23
Reflex	Pre (N=162)	6.47	-1.14
	Post (N=15)	5.67	-1.76
ST Math	Pre (N=576)	6.39	-1.15
	Post (N=194)	6.03	-1.34
TTM	Pre (N=31)	6	-1.61
	Post (N=1,522)	6.32	-1.13
Successmaker	Pre (N=2,863)	6.51	-0.99
	Post (N=24)	5.67	-1.46

Table 14. How important is it to you to get good grades in math?

The third prompt asked students how useful is learning math for their future. In general, most students think that learning math for their future is "very useful." Although most products had a decrease, the majority of students still thought that math would be useful after graduation from high school. On a 7-point scale, the most notable changes were: A 0.75-point increase for Math XL; a 1.09-point decrease for Successmaker; and a 1.26-point decrease for Reflex Math (See Table 15). Again we note that the large decreases may be due to large changes in response size between pre and post-surveys.

Pre



Post

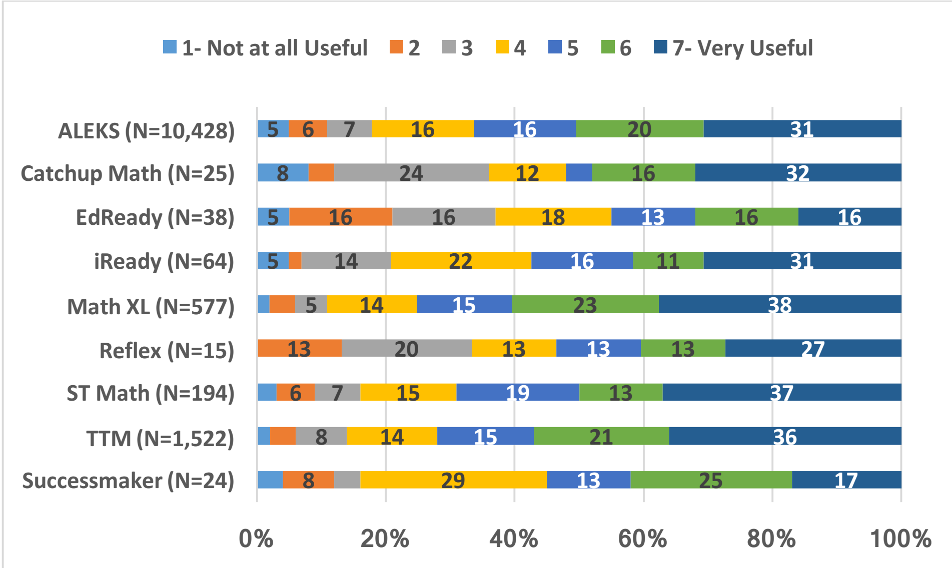


Figure 17. How useful is learning math for what you want to do after you graduate from high school or college and go to work?
Labels have been excluded for values less than 5%.

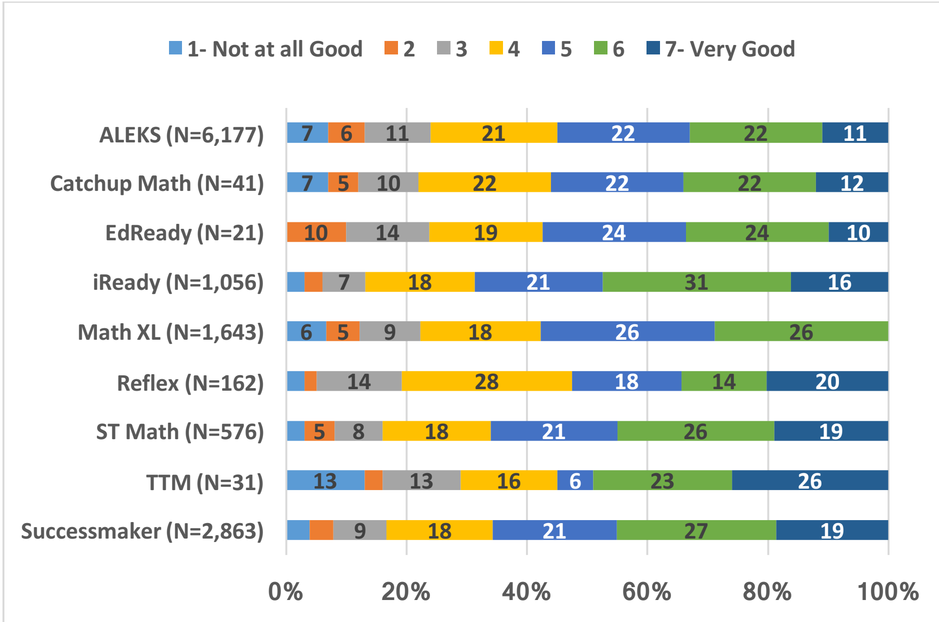
Product	**Sample Size**	**Mean**	**(*SD*)**
ALEKS	Pre (N=6,177)	5.3	-1.75
	Post (N=10,428)	5.15	-1.77
Catchup Math	Pre (N=41)	5.1	-1.96
	Post (N=25)	4.76	-2.07
EdReady	Pre (N=1,643)	4.95	-1.66
	Post (N=577)	4.29	-1.86
iReady	Pre (N=1,056)	5.87	-1.42
	Post (N=64)	5	-1.75
Math XL	Pre (N=1,643)	4.82	-1.79
	Post (N=577)	5.57	-1.53
Reflex	Pre (N=162)	5.99	-1.43
	Post (N=15)	4.73	-1.87
ST Math	Pre (N=576)	5.82	-1.56
	Post (N=194)	5.28	-1.75

TTM	Pre (N=31)	4.65	-2.17
	Post (N=1,522)	5.41	-1.63
Successmaker	Pre (N=2,863)	5.88	-1.47
	Post (N=24)	4.79	-1.69

Table 15. How useful is learning math for what you want to do after you graduate from high school or college and go to work?

The fourth prompts asked students how “good are you at math.” At the beginning of the school year, the pre-survey responses were nearly uniform across products, with the majority of students responding that they thought that they were “good at math.” The post-survey responses had more variation, but still showed that students had positive self-perceptions with regard to their efficacy in math. Two exceptions to this trend, were EdReady and Reflex Math, both of which had student responses closer to a “neutral” feeling with regard to self-efficacy in math. This trend, however, may be attributed to the small sample size for both of these products. On a 7-point scale, three notable changes were: A 1.33-point decrease in Reflex Math users; a 1.04-point decrease for EdReady; and a 0.8-point decrease for iReady (See Table 16). Although each of these products had a decrease, overall the students still had positive self-perceptions with regard to their self-efficacy in mathematics.

Pre



Post

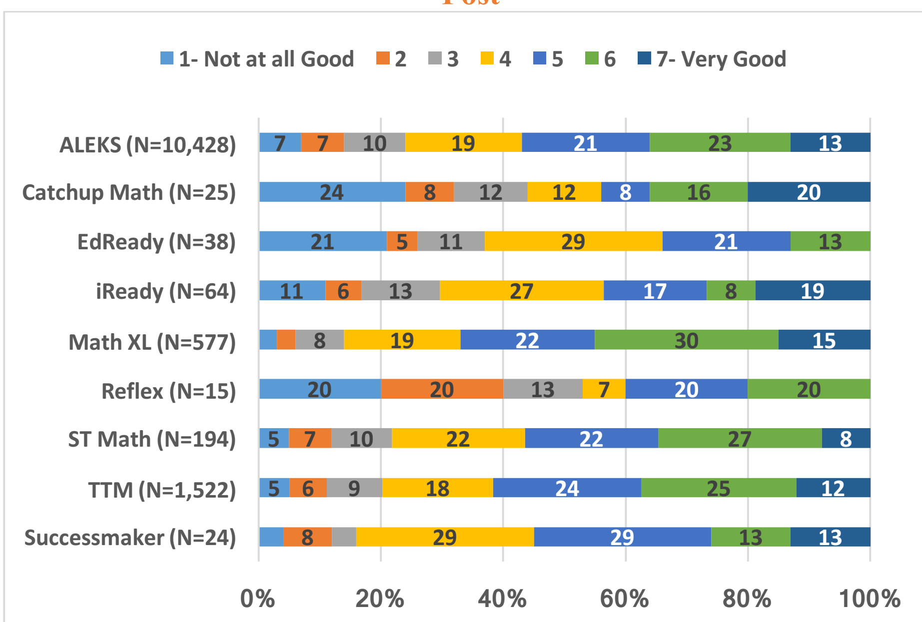


Figure 18. How good at math are you?
Labels have been excluded for values less than 5%.

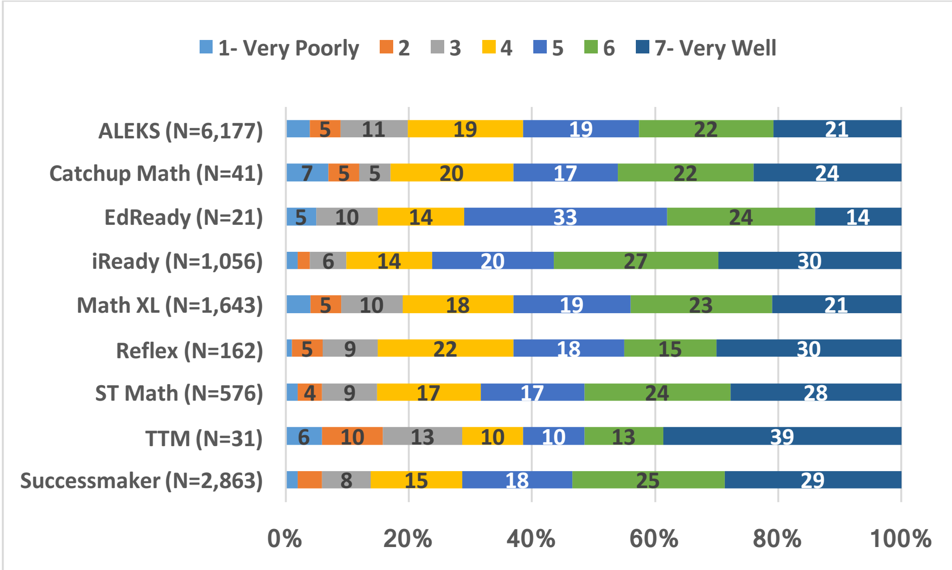
Product	Sample Size	Mean	(*SD*)
ALEKS	Pre (N=6,177)	4.57	-1.66
	Post (N=10,428)	4.61	-1.72

Catchup Math	Pre (N=41)	4.61	-1.69
	Post (N=25)	4	-2.31
EdReady	Pre (N=1,643)	4.67	-1.49
	Post (N=577)	3.63	-1.7
iReady	Pre (N=1,056)	5.11	-1.47
	Post (N=64)	4.31	-1.87
Math XL	Pre (N=1,643)	4.7	-1.59
	Post (N=577)	5.06	-1.46
Reflex	Pre (N=162)	4.8	-1.57
	Post (N=15)	3.47	-1.92
ST Math	Pre (N=576)	5.04	-1.56
	Post (N=194)	4.61	-1.59
TTM	Pre (N=31)	4.71	-2.08
	Post (N=1,522)	4.73	-1.62
Successmaker	Pre (N=2,863)	5.02	-1.58
	Post (N=24)	4.58	-1.56

Table 16. How good at math are you?

The fifth prompt asked students "how have you been doing in math?" Although there was an overall decrease in student perceptions with regard to how they felt they were doing in math, research has shown that students attitudes tend to decrease throughout the academic year (Chouinard & Roy, 2008; Leder & Forgasz, 2002; Middleton et. al., 2004; Onatsu-Arvilommi & Nurmi, 2000; Watt, 2000). Thus, some negative change is anticipated. In contrast to this trend, Math XL had a .45-point increase on a 7-point scale. Other than Math XL, the most notable changes were, a 1.02-point decrease for Reflex Math and a 1.1-point decrease for Catchup Math (See Table 17).

Pre



Post

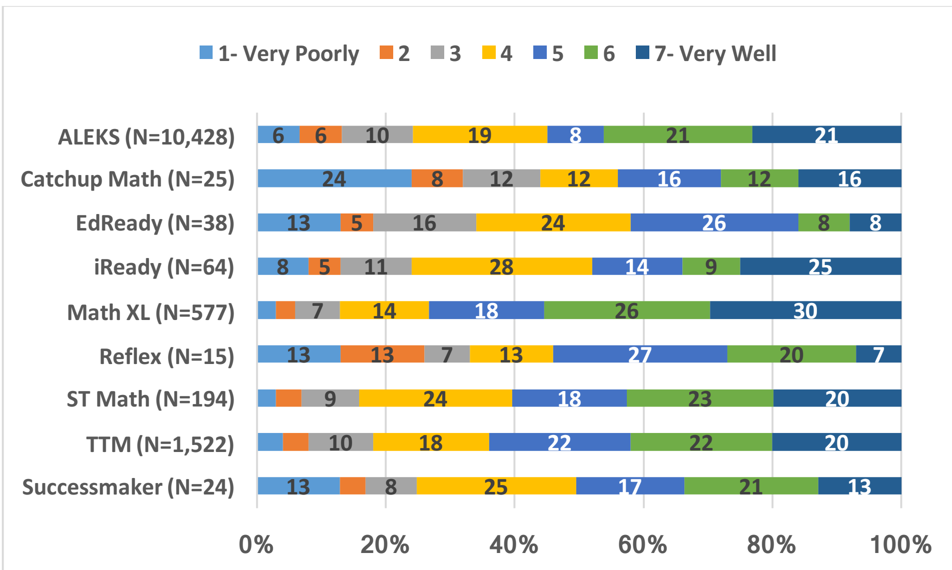


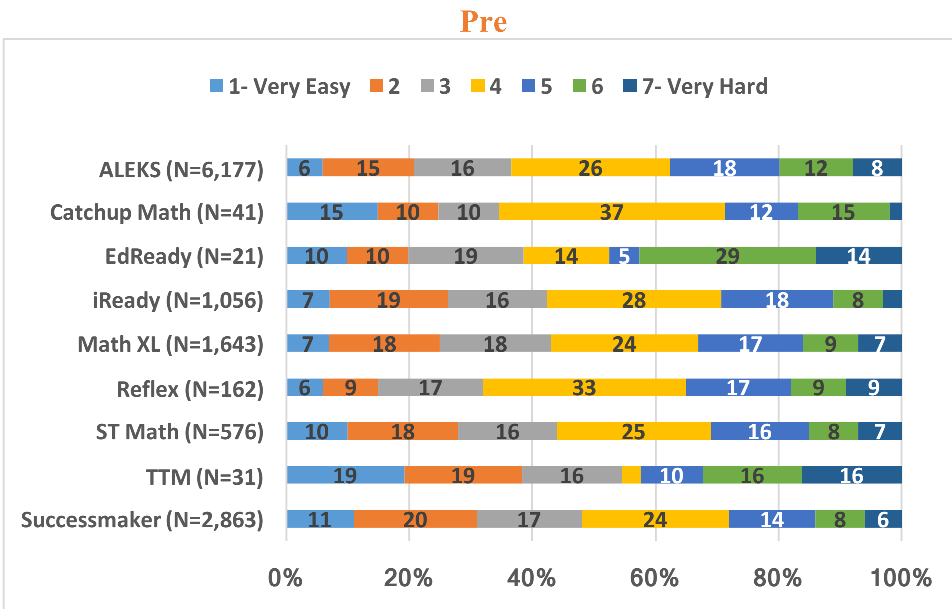
Figure 19. Currently, how have you been doing in math?
Labels have been excluded for values less than 5%.

Product	**Sample Size**	**Mean**	**(*SD*)**
ALEKS	Pre (N=6,177)	4.93	-1.65
	Post (N=10,428)	4.84	-1.74
Catchup Math	Pre (N=41)	4.98	-1.81
	Post (N=25)	3.88	-2.2
EdReady	Pre (N=1,643)	5	-1.48
	Post (N=577)	4	-1.71

iReady	Pre (N=1,056)	5.48	-1.43
	Post (N=64)	4.64	-1.85
Math XL	Pre (N=1,643)	4.94	-1.67
	Post (N=577)	5.39	-1.54
Reflex	Pre (N=162)	5.15	-1.59
	Post (N=15)	4.13	-1.92
ST Math	Pre (N=576)	5.26	-1.57
	Post (N=194)	4.97	-1.56
TTM	Pre (N=31)	5	-2.08
	Post (N=1,522)	4.96	-1.63
Successmaker	Pre (N=2,863)	5.31	-1.57
	Post (N=24)	4.42	-1.86

Table 17. Currently, how have you been doing in math?

Lastly, the sixth prompt asked students "In general, how hard is math for you?" In contrast to the previous four prompts, the data describing how hard students perceived math, was far closer to a normal distribution. These data are consistent with the extant literature that shows that students abilities increase as the school year progresses, while their desire to complete more difficult tasks decreases (Chouinard & Roy, 2008; Leder & Forgasz, 2002; Middleton et. al., 2004; Onatsu-Arvilommi & Nurmi, 2000; Watt, 2000). Thus, we would anticipate an increase in students' perceptions of math difficulty as the school year progresses. On a 7-point scale, the most notable changes include: a 0.64-point increase for users of Catchup Math, a 0.3-point increase for EdReady, and a 0.32-point increase for users of the iReady product (See Table 18).



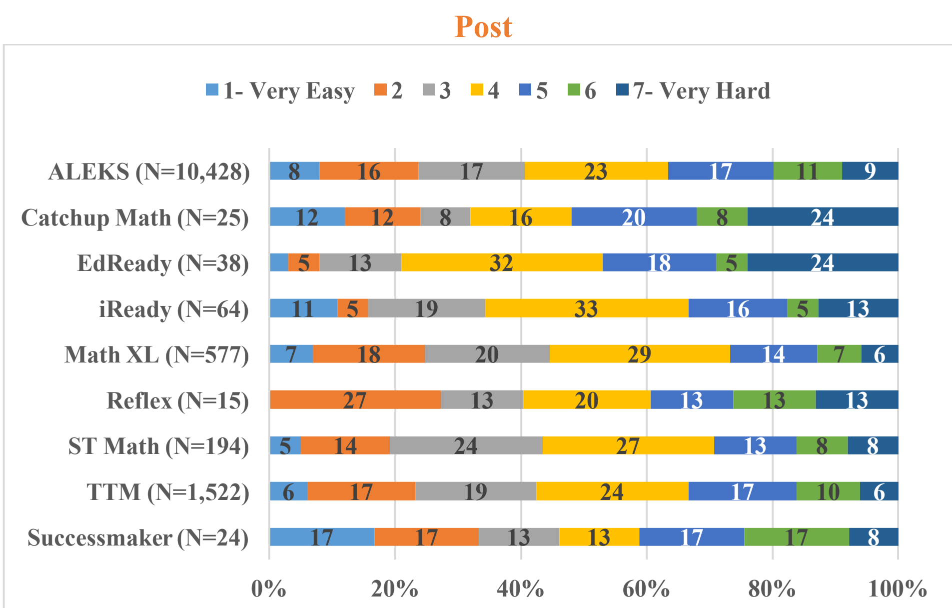


Figure 20. In general, how hard is math for you?

Product	Sample Size	Mean	(*SD*)
ALEKS	Pre (N=6,177)	4.03	-1.64
	Post (N=10,428)	3.96	-1.71
Catchup Math	Pre (N=41)	3.76	-1.65
	Post (N=25)	4.4	-2.08

EdReady	Pre (N=1,643)	4.38	-1.99
	Post (N=577)	4.68	-1.65
iReady	Pre (N=1,056)	3.7	-1.11
	Post (N=64)	4.02	-1.69
Math XL	Pre (N=1,643)	3.82	-1.62
	Post (N=577)	3.7	-1.56
Reflex	Pre (N=162)	4.12	-1.55
	Post (N=15)	4.13	-1.81
ST Math	Pre (N=576)	3.69	-1.67
	Post (N=194)	3.85	-1.58
TTM	Pre (N=31)	3.77	-2.23
	Post (N=1,522)	3.86	-1.6
Successmaker	Pre (N=2,863)	3.58	-1.66
	Post (N=24)	3.79	-2

Table 18. In general, how hard is math for you?

Student Survey Discussion and Summary

Nine mathematics instructional software products were funded through the STEM Action Center to provide supplemental instruction to Utah K-12 students. Although some of the data suggests that students' math perceptions experienced a negative change over the school year, research shows that students tend to demonstrate greater excitement and engagement towards mathmatics at the beginning of the school year, compared to the end of the year (Chouinard & Roy, 2008; Leder & Forgasz, 2002; Middleton et. al., 2004; Onatsu-Arvilommi & Nurmi, 2000; Watt, 2000). Research also shows that, although skills and knowledge in mathmatics improve over the course of an academic year, task avoidance for mathmatics, motivation towards mathmatics, and student perceptions regarding mathematical ability decrease as the school year progresses (Chouinard & Roy, 2008; Leder & Forgasz, 2002; Middleton et. al., 2004; Onatsu-Arvilommi & Nurmi, 2000; Watt, 2000). As a result, students' compentency in mathmatics may have increased, while their percpetions regarding mathmatics may have decreased. In particular, students may view math and mathematical tasks more negatively toward the end of the school year, while simultaneously experiencing gains in math skills and knowledge. Much of the data regarding students' math perceptions showed minor changes. In light of the expected decrease in math perceptions shown in the research noted above, small negative change in student math perceptions imply that no change may actually be a positive change.

In Tables 19 and 20 below, we also summarize the changes in K-6 and 7-12 students' math interest from pre to post-surveys. As seen in these tables, mean differences in K-6 and 7-12 student interest and engagement in math varied by product, but remain relativlely constant throughout the year. Most survey responses showed positive perceptions of both math in general and mathematical tasks. As noted previously, small changes in perceptions throughout the academic year, may imply the software had a positive effect on student perceptions of math.

Summary

Perception Area	**Prompts**	**Scale**		**ALEKS**	
				Pre (N=1,283)	Post (N=2,823)
Average Rating Scale					
Math at School	**How do you feel about doing math in class?**	**1 to 5**	**Mean**	3.65	3.8
			(*SD*)	-1.3	-1.18
Intrinsic Interest	**How much do you like math?**	**1 to 5**	**Mean**	3.64	3.6
			(*SD*)	-1.39	-1.34
Difficulty of Task	**How is math for you compared to other things you learn in school?**	**0 to 10**	**Mean**	4.72	5.19
			(*SD*)	-2.8	-2.61
Percent with Yes Values				Pre	Post
Utility of Math	**Will you need math when you get older and get a job?**	**Yes/ No**		89%	91%

Perception Area	Prompts	Scale		iReady	
				Pre (N=3,049)	Post (N=2,814)
Average Rating Scale					
Math at School	How do you feel about doing math in class?	1 to 5	Mean	3.99	3.92
			(*SD*)	-1.27	-1.17
Intrinsic Interest	How much do you like math?	1 to 5	Mean	4	3.9
			(*SD*)	-1.32	-1.28
Difficulty of Task	How is math for you compared to other things you learn in school?	0 to 10	Mean	4.64	4.94
			(*SD*)	(2.97	-2.63
Percent with Yes Values				Pre	Post
Utility of Math	Will you need math when you get older and get a job?	Yes/ No		86%	94%
Perception Area	**Prompts**	**Scale**		**Reflex**	
				Pre (N=29)	Post (N=314)
Average Rating Scale					
Math at School	How do you feel about doing math in class?	1 to 5	Mean	3.17	3.82
			(*SD*)	-1.2	-1.23
Intrinsic Interest	How much do you like math?	1 to 5	Mean	3.59	3.66
			(*SD*)	-1.4	-1.42
Difficulty of Task	How is math for you compared to other things you learn in school?	1 to 10	Mean	5.28	5.17
			(*SD*)	-2.83	-2.71
Percent with Yes Values				Pre	Post
Utility of Math	Will you need math when you get older and get a job?	Yes/ No		90%	89%
Perception Area	**Prompts**	**Scale**		**ST Math**	

Average Rating Scale				Pre (N=2,423)	Post (N=6,392)
Math at School	**How do you feel about doing math in class?**	**1 to 5**	**Mean**	3.98	3.9
			(*SD*)	-1.15	-1.17
Intrinsic Interest	**How much do you like math?**	**1 to 5**	**Mean**	3.95	3.79
			(*SD*)	-1.25	-1.32
Difficulty of Task	**How is math for you compared to other things you learn in school?**	**2 to 10**	**Mean**	5.06	5.04
			(*SD*)	-2.73	-2.61
Percent with Yes Values				Pre	Post
Utility of Math	**Will you need math when you get older and get a job?**	**Yes/ No**		95%	94%
Perception Area	**Prompts**	**Scale**		**TTM**	
Average Rating Scale				Pre (N=3,629)	Post (N=3,101)
Math at School	**How do you feel about doing math in class?**	**1 to 5**	**Mean**	4.03	3.8
			(*SD*)	-1.27	-1.25
Intrinsic Interest	**How much do you like math?**	**1 to 5**	**Mean**	4.03	3.79
			(*SD*)	-1.31	-1.37
Difficulty of Task	**How is math for you compared to other things you learn in school?**	**3 to 10**	**Mean**	4.98	5.06
			(*SD*)	-3.19	-2.77
Percent with Yes Values				Pre	Post
Utility of Math	**Will you need math when you get older and get a job?**	**Yes/ No**		86%	90%
Perception Area	**Prompts**	**Scale**		**Successmaker**	
Average Rating Scale				Pre (N=435)	Post (N=530)

Math at School	**How do you feel about doing math in class?**	**1 to 5**	**Mean**	4	3.93
			(SD)	-1.24	-1.19
Intrinsic Interest	**How much do you like math?**	**1 to 5**	**Mean**	3.93	3.86
			(SD)	-1.33	-1.31
Difficulty of Task	**How is math for you compared to other things you learn in school?**	**4 to 10**	**Mean**	4.92	4.99
			(SD)	-2.77	-2.77
Percent with Yes Values				Pre	Post
Utility of Math	**Will you need math when you get older and get a job?**	**Yes/ No**		94%	95%

Table 19. Changes in Math Interest and Engagement by Product (K-6)
Note. The values in the table represent the average score on a scale of 1 to 5, where 5 is very positive (smiley face), 3 is neutral, and 1 is very negative or an item with a scale of 0 to 10 where 0 is very easy and 10 is very difficult.

Perception Area	**Questions**		**ALEKS**		**Catchup Math**	
			Pre (N=6,177)	Post (N=10,428)	Pre (N=41)	Post (N=25)
Intrinsic Interest Value	**How much do you like doing math?**	**Mean**	3.51)	3.49	3.9	3.76
		(SD)	(*SD*= 1.86)	-1.86	-1.96	-2.18
Extrinsic Utility Value	**How useful is learning math?**	**Mean**	5.3	5.15	5.1	4.76
		(SD)	-1.75	-1.77	-1.96	-2.07
Attainment Value	**How important is math?**	**Mean**	6.33	6.18	6.15	5.4
		(SD)	-1.17	-1.29	-1.44	-1.91
	How good at math are you?	**Mean**	4.57	4.61	4.61	4
		(SD)	-1.66	-1.72	-1.69	-2.31
	How have you been doing in math?	**Mean**	4.93	4.84	4.98	3.88
		(SD)	-1.65	-1.74	-1.81	-2.2
	How hard is math?	**Mean**	4.03	3.96	3.76	4.4

		SD	-1.64	-1.71	-1.65	-2.08
Perception Area	**Questions**		**EdReady**		**iReady**	
			Pre (N=21)	Post (N=38)	Pre (N=1,056)	Post (N=64)
Intrinsic Interest Value	**How much do you like doing math?**	**Mean**	3.38	2.79	4.37	4.2
		(*SD*)	-1.94	-1.61	-1.85	-1.77
Extrinsic Utility Value	**How useful is learning math?**	**Mean**	4.95	4.29	5.87	5
		(*SD*)	-1.66	-1.86	-1.42	-1.75
Attainment Value	**How important is math?**	**Mean**	6.19	5.66	6.57	5.48
		(*SD*)	-1.21	-1.7	-0.98	-1.87
	How good at math are you?	**Mean**	4.67	3.63	5.11	4.31
		(*SD*)	-1.49	-1.7	-1.47	-1.87
	How have you been doing in math?	**Mean**	5	4	5.48	4.64
		(*SD*)	-1.48	-1.71	-1.43	-1.85
	How hard is math?	**Mean**	4.38	4.68	3.7	4.02
		(*SD*)	-1.99	-1.65	-1.11	-1.69
Perception Area	**Questions**		**Math XL**		**Reflex**	
			Pre (N=1,643)	Post (N=577)	Pre (N=162)	Post (N=15)
Intrinsic Interest Value	**How much do you like doing math?**	**Mean**	3.57	4.47	4.33	3
		(*SD*)	-1.8	-1.91	-1.94	-1.81
Extrinsic Utility Value	**How useful is learning math?**	**Mean**	4.82	5.57	5.99	4.73
		(*SD*)	-1.79	-1.53	-1.43	-1.87
Attainment Value	**How important is math?**	**Mean**	6.25	6.29	6.47	5.67
		(*SD*)	-1.25	-1.23	-1.14	-1.76
	How good at math are you?	**Mean**	4.7	5.06	4.8	3.47
		(*SD*)	-1.59	-1.46	-1.57	-1.92
	How have you been doing in math?	**Mean**	4.94	5.39	5.15	4.13
		(*SD*)	-1.67	-1.54	-1.59	-1.92
	How hard is math?	**Mean**	3.82	3.7	4.12	4.13
		(*SD*)	-1.62	-1.56	-1.55	-1.81

Perception Area	Questions		ST Math		TTM	
			Pre (N=576)	Post (N=194)	Pre (N=31)	Post (N=1,522)
Intrinsic Interest Value	**How much do you like doing math?**	**Mean**	4.43	4.01	3.81	3.68
		(*SD*)	-1.94	-1.95	-1.99	-1.85
Extrinsic Utility Value	**How useful is learning math?**	**Mean**	5.82	5.28	4.65	5.41
		(*SD*)	-1.56	-1.75	-2.17	-1.63
Attainment Value	**How important is math?**	**Mean**	6.39	6.03	6	6.32
		(*SD*)	-1.15	-1.34	-1.61	-1.13
	How good at math are you?	**Mean**	5.04	4.61	4.71	4.73
		(*SD*)	-1.56	-1.59	-2.08	-1.62
	How have you been doing in math?	**Mean**	5.26	4.97	5	4.96
		(*SD*)	-1.57	-1.56	-2.08	-1.63
	How hard is math?	**Mean**	3.69	3.85	3.77	3.86
		(*SD*)	-1.67	-1.58	-2.23	-1.6

Perception Area	Questions		Successmaker	
			Pre (N=2,863)	Post (N=24)
Intrinsic Interest Value	**How much do you like doing math?**	**Mean**	4.31	3.83
		(*SD*)	-1.93	-2.28
Extrinsic Utility Value	**How useful is learning math?**	**Mean**	5.88	4.79
		(*SD*)	-1.47	-1.69
Attainment Value	**How important is math?**	**Mean**	6.51	5.67
		(*SD*)	-0.99	-1.46
	How good at math are you?	**Mean**	5.02	4.58
		(*SD*)	-1.58	-1.56
	How have you been doing in math?	**Mean**	5.31	4.42
		(*SD*)	-1.57	-1.86
	How hard is math?	**Mean**	3.58	3.79
		(*SD*)	-1.66	-2

Table 20. Changes in Math Interest and Engagement by Product (7-12)

Student Qualitative Results

Intro

The student pre and post-surveys included free-response questions designed to elicit feedback regarding the particulars of software use. The free-response format of these prompts provided more diverse and detailed responses compared to the multiple choice prompts included in the student surveys. The prompts were administered to students ranging from the 7th through 12th grades at both the beginning and end of the 2015-2016 school year. These prompts follow:

- *"Tell us what you like about the math computer game you used"*
- *"Tell us what you do not like about the math computer game you used"*

Qualitative Survey Results for Grades 7 through 8

The two prompts included in the 7th through 8th grade surveys were "Tell us what you like about the math computer game you used," and "Tell us what you do not like about the math computer game you used." A random sample of 372 was taken from 12,612 pre-survey responses and 373 were taken from 13,965 post-survey responses. The decision regarding sampling size was based on a conventional statistical procedure known as power analysis, which is employed to determine the appropriate sample size needed to reduce the risk of sampling error to a negligible level.

Prompt 1: *Tell us what you like about the math computer game you used*

For the prompt, "Tell us what you like about the math computer game you used" both pre (N= 488) and post (519) comments were categorized. Note that, while only 372 pre-survey responses and 373 post-survey responses were sampled, a single response may include several comments, thus the number of total comments exceeds the number of responses for both the pre and post-surveys. A summary of the composition of responses to this survey prompt is given in Table 21.

	PRE		POST		
Category	**N**	**As Percent of Total Comments**	**N**	**As Percent of Total Comments**	**Representative Comment**
Nothing	115	23.57%	99	19.08%	"Nothing"
It helped me learn	92	18.85%	57	10.98%	"It helps me review and learn about things again."
Technical aspects of the program (ease of use, layout, etc.)	71	14.55%	130	25.05%	"I like how it never glitches."
It was helpful, it had clear explanations	68	13.93%	110	21.19%	"It's awesome because it helps you more with math. It is also easy to do when you're at home."
It was fun, fun games	39	7.99%	23	4.43%	"that it is easy and fun to play."
Self-paced, on the students level	28	5.73%	41	7.90%	"I like that we are able to move at our own pace, not having to wait for the entire class to catch up or having to be behind everyone on something we don't understand."
Points, reward system, avatar customization	23	4.71%	11	2.12%	"You get to customize your avatar."
Challenging material	20	4.10%	8	1.54%	"I like aleks because it challenges us and it makes sure that you do the topic right."
Helpful reviews of material already learned	17	3.93%	21	4.05%	"it helped me study for tests"
Not enough experience with the program	11	2.25%	0	----	"I have not started this computer game yet."
Other	1	0.20%	19	3.66%	*No response*
	Total= 488		**Total =519**		

Table 21. 7th-12th Survey Prompt: Tell us what you like about the math computer game you use. (Write "nothing" if there is nothing...)

Prompt 2: *Tell us what you do not like about the math computer game you used*

For the prompt, "Tell us what you do not like about the math computer game you used," we observed a 15.52 percentage-point decrease in the number respondents writing "nothing." This was accompanied by 7.3 percentage-point increase in those noting that the software took too much time and a 5.05 percentage-point increase in the number of respondents stating that it was unclear or hard to understand. The categories with the largest overall percentage in both pre and post-surveys were "Nothing" and "It was poorly set up, there were problems with the program."

	PRE		POST		
Category	**N**	**As Percent of Total Comments**	**N**	**As Percent of Total Comments**	**Representative Comment**
Nothing	152	35.02%	101	19.50%	"Nothing"
It was poorly set up, there were problems with the program	90	20.74%	108	20.85%	"I don't like that it will skip a subject if you work on it for a while and can't get it. I would rather keep working on something until I get it, rather than having to come back to it later."
It was too much work, took too much time	32	7.37%	76	14.67%	"it takes up alot of time"
Other	28	6.45%	31	5.98%	"I don't like it"
It was difficult	28	6.45%	27	5.21%	"It's too hard also confusing. We basically have to teach ourselves if it's not stuff the teacher taught us. It also doesn't let you choose the ones you

					need to finish or give you more options.”
It was boring	27	6.22%	31	5.98%	“Its really boring. I wish they made it more interactive and stuff.”
It was unclear, it was hard to understand	25	5.76%	56	10.81%	“it does not explain the work at all”
It was not on my level, too hard or too easy, too young	19	4.38%	23	4.44%	“its hard we have questions that have not learned”
Didn’t like everything about it	12	2.77%	25	4.83%	“Everything”
Not enough experience with the program	10	2.30%	0	----	“Never used it.”
It was not helpful, it was not needed	8	1.84%	31	5.98%	“it doesn't help me figure out what um doing wrong. It just tells me that something is wrong in my problem.”
Didn’t like it as homework	3	0.69%	9	1.74%	“homework”
	Total= 434		**Total = 518**		

Table 22. Tell us what you do not like about the math computer game you use. (Write "nothing" if there is...)

Discussion

Some students responded that the software “helped them learn.” Others emphasized that the software was helpful at reviewing “material already learned.” Comments in these two categories appear to emphasize the supplementary nature of the software use. This may suggest that the instructional software is being used in more of a supplementary way, rather than a direct knowledge acquisition tool, which is consistent with the aim of the mathematical instructional software grant program.

Consistent with teachers use of the math software, students noted that they liked the self-pacing feature of the software. One student stated, “I like that we are able to move at our own pace, not having to wait for the entire class to catch up or having to be behind everyone on something we don't understand.” This comment ties in the supplementary use of the software found in the teacher survey data, which showed that teachers often used the software to assist students who were behind or above grade level.

Some students speak of the software being either too difficult or too easy. It may be fruitful to investigate to what degree the software is not calibrated in matching its instruction to the typical student’s needs. This is a delicate matter given that some students report enjoying the challenge while others report feeling overwhelmed and discouraged. Ideally, the software would be customized for individual instruction so that it is challenging enough to maximize their cognitive growth but not so difficult as to discourage interest, and thus further development. Many of the funded software products advertise this as a feature, thus, analyzing the extent to which these claims hold true would be worth further investigation, but beyond the scope of this research evaluation study.

Given that the open coding methodology is generally employed as a discovery tool, we are now formalizing ways that this information can further be used to improve the evaluation process. Follow up questions have been included in next year’s survey to further inquire about the prominent areas of both success and concern regarding the math software. For instance, some respondents mentioned that the software was boring. If we can find out more specifically what aspects of the software students find uninteresting, we may be able to recommend methods for increasing student engagement.

Teacher Survey Results

Quantitative Results

A pre and post-survey was administered to teachers during the 2015-2016 academic year to understand their perceptions regarding the six distributed mathematics instructional software products. The surveys included a total of three Likert scale type prompts each with between 5 and 8 sub-prompts, along with three open-ended follow-up prompts. The results that follow have been divided by product with the pre-survey result on the left and the post-survey results on the right of each figure. Because each product did not receive responses to each prompt, some figures show fewer than seven responses in the pre-survey figure, while others show fewer responses in the post-survey figure.

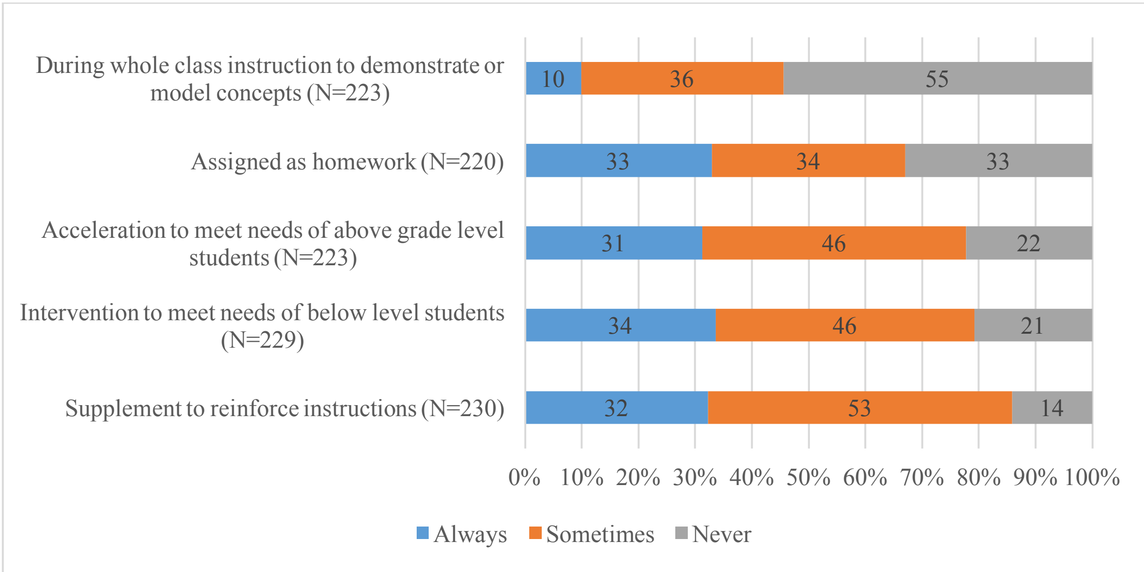
A total of nine products were distributed through the Mathematics Instructional Software grant program, of these, three products (i.e., Catchup Math, EdReady, and Successmaker) had fewer than 10 survey responses. Due to low response size, these have been omitted from the results.

Two additional sub-prompts were added to the post-survey asking teachers to "Please describe how you used the technology product in the last 30 days." The second question asked teachers to "Describe whether you had any barriers that prevented you from using the product with your students as they would have liked. The final question asked teachers to "Describe how you have been using the data reporting features of the product."

For aesthetic purposes, labels on each bar graph were excluded for responses that were less than five percent. The response size (N) for each sub-prompt was included to show differences between the number of survey responses by product. The following tables represent the survey responses, and are separated by product.

ALEKS

Pre (N=237)



Post (N=462)

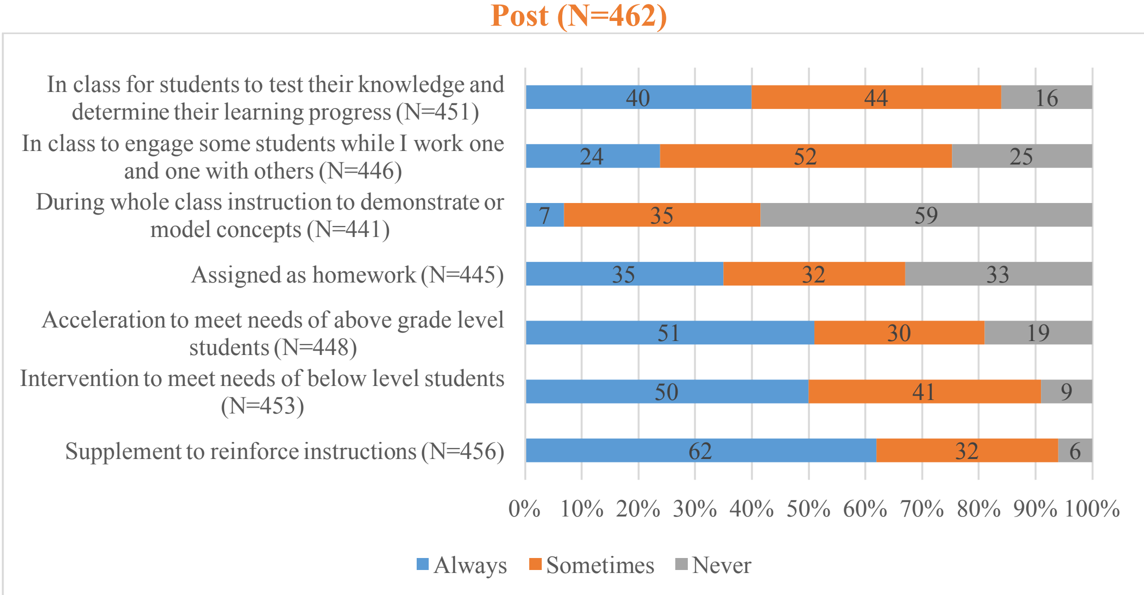
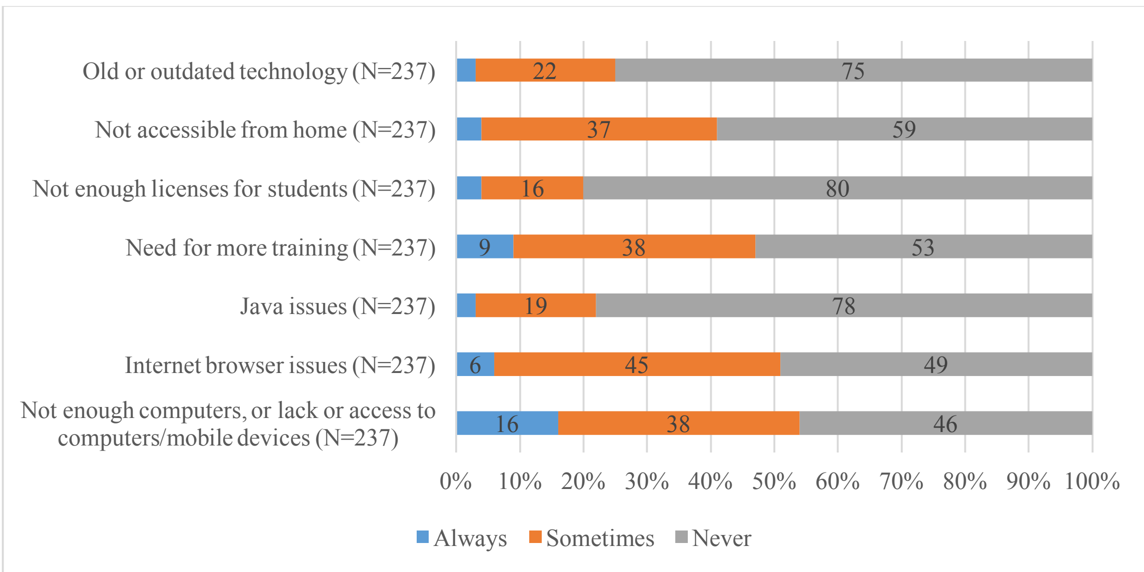


Figure 21. ALEKS: Please describe how you used the technology product in the last 30 days

Figure 21 shows significant changes between the teacher pre and post responses. In particular, there was an increase in the number of teachers who said that they used the product as a "Supplement to reinforce instructions" (62%). There were also increases in the responses for

"Intervention to meet [the] needs of below level students" (50%), and "Acceleration to meet [the] needs of above grade level students" (51%). There are also two survey items that were not available in the pre-survey, but available in the post. These are "In class for students to test their knowledge and determine their learning progress" and "In class to engage some students while I work one and one with others."

Pre (N=237)



Post (N=462)

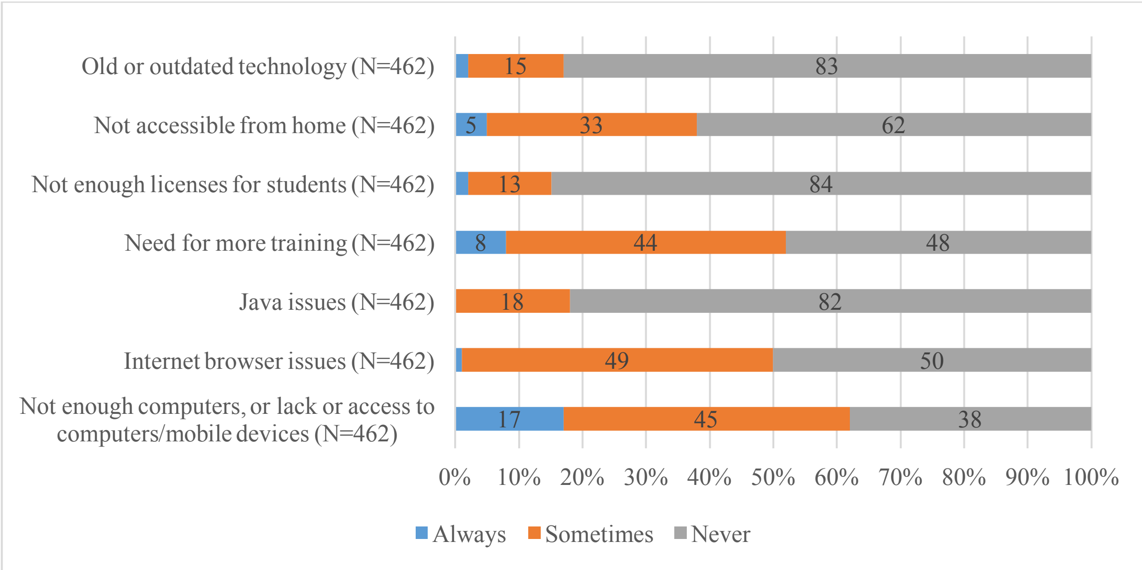


Figure 22. ALEKS: Describe whether you had any barriers that prevented you from using the product with your students as you would have liked

Very few responses described constant barriers to the implementation of the mathematics instructional software, however, there were significant responses noting that teachers "Sometimes" experienced difficulties (see Table 22). The most notable were related to the lack of available computers and technical issues. There was also a significant number of responses requesting further training related to the software. With the exception of these issues, the majority of teachers noted that they "Never" experienced barriers to software use.

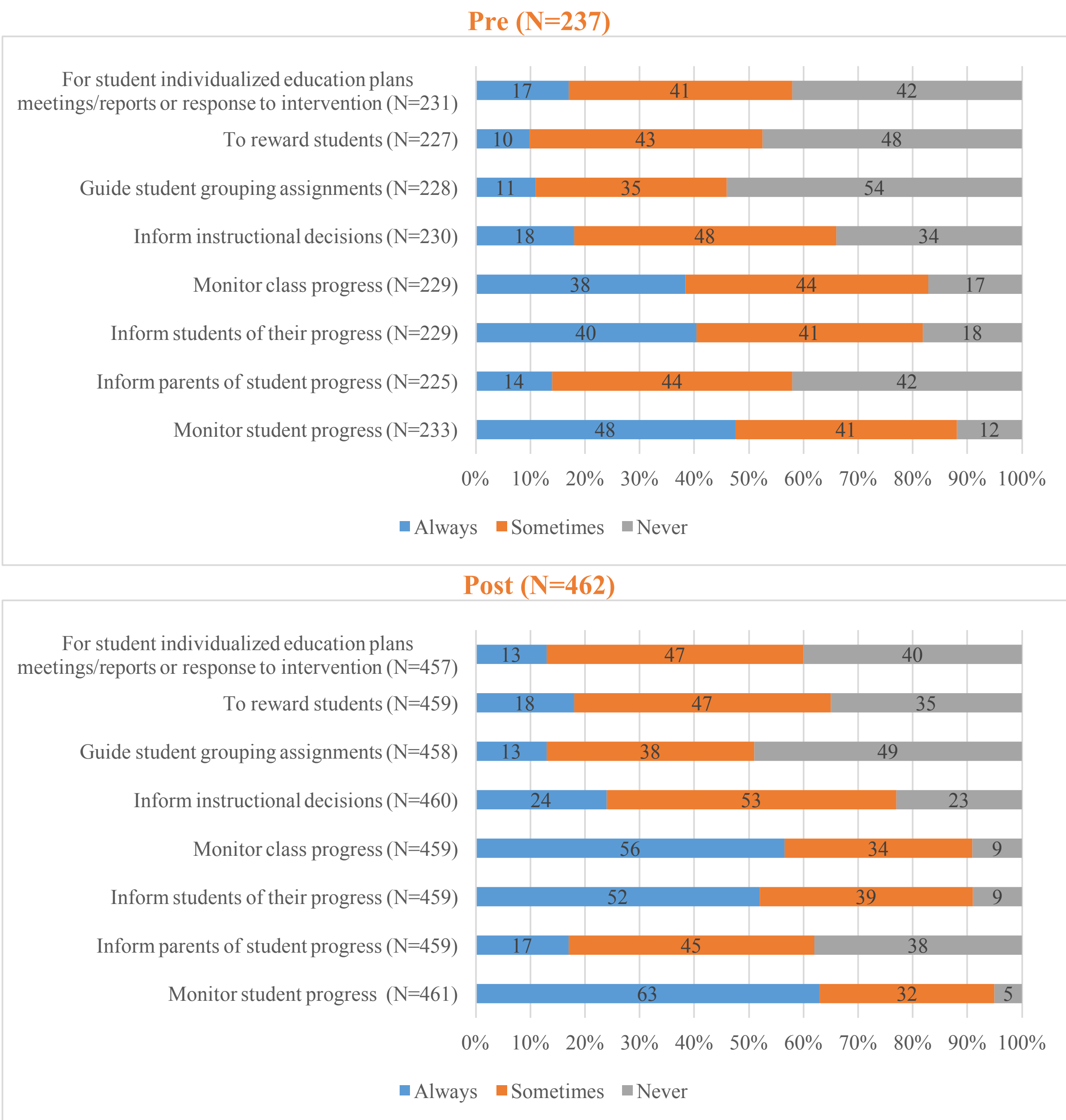


Figure 23- ALEKS: Please describe how you have been using the data reporting features of the product

As seen in Figure 23, three areas showed significant increase from pre-survey to post-survey for the question "Please describe how you have been using the data reporting features of the product." These are: "Monitor class progress" (56% post), "Inform students of their progress" (52% post), and "Monitor student progress" (63% post). These three areas had a percentage point increase of 18%, 12%, and 15%, respectively. No area saw significant gains in the “Never” category from pre to post-survey.

iReady

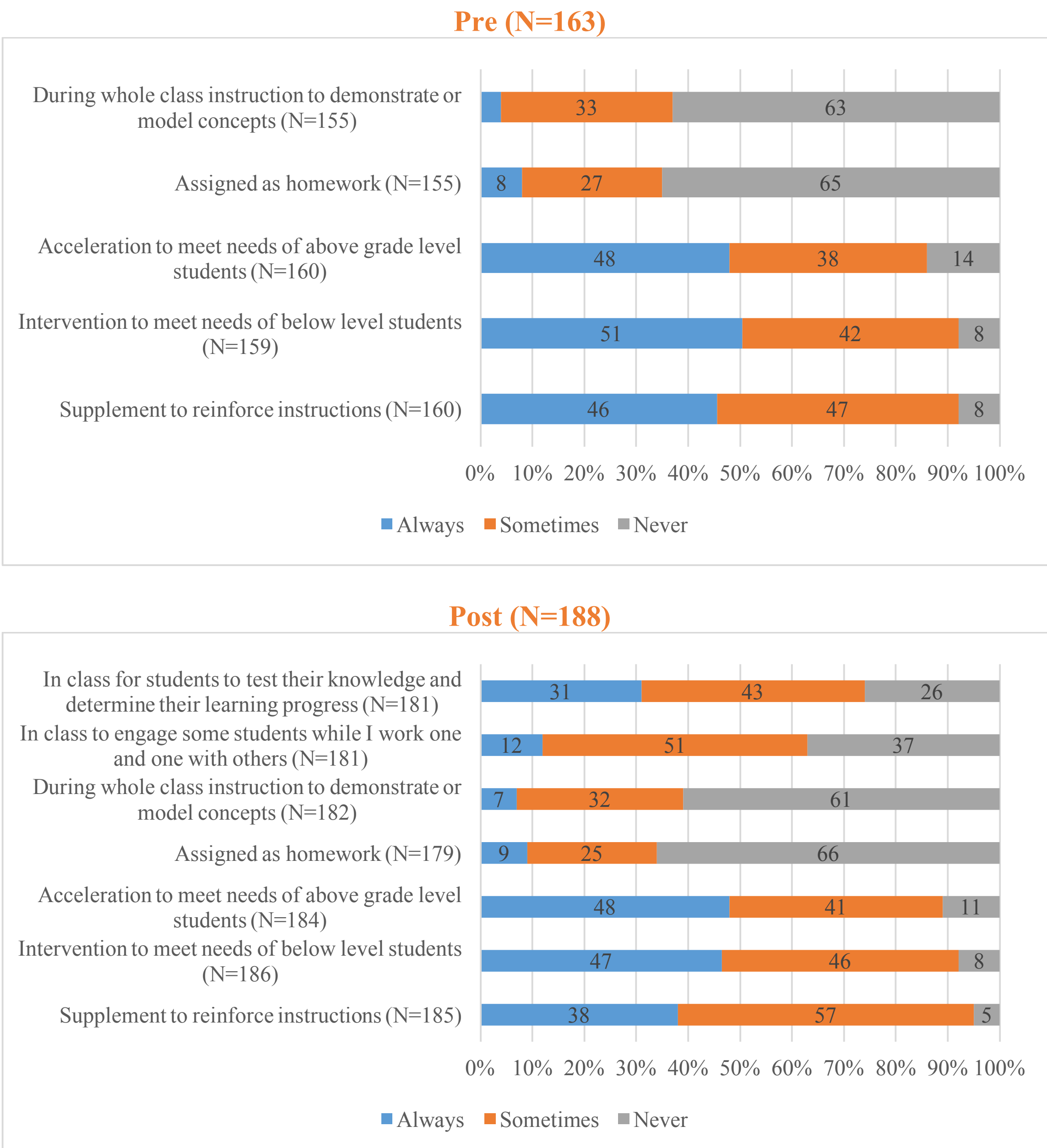
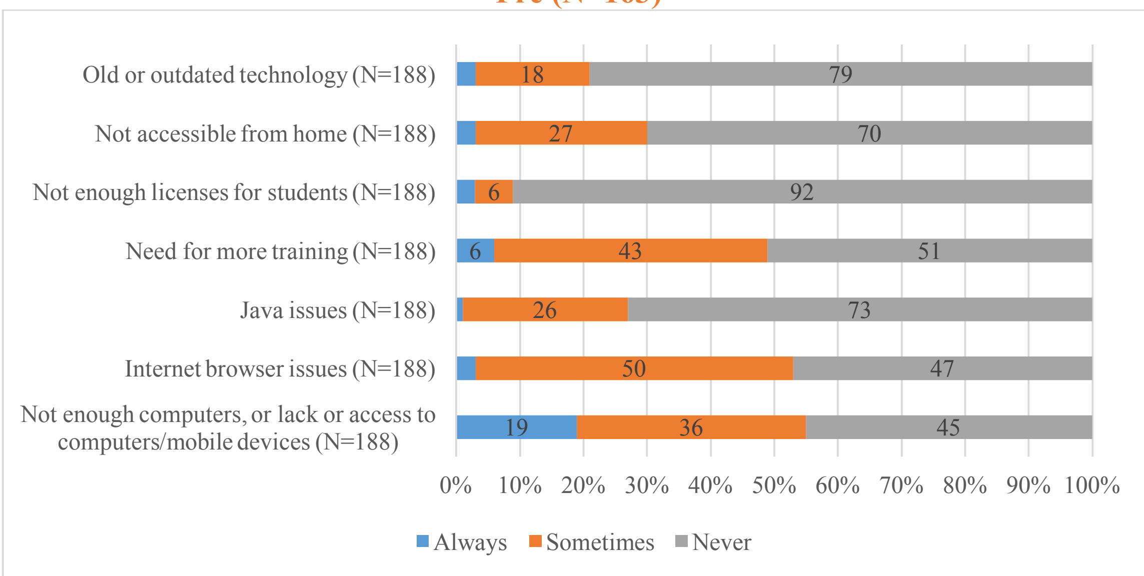


Figure 24. iReady: Please describe how you used the technology product in the last 30 days

The question, “Please describe how you used the technology product in the last 30 days” did not have any major response changes from pre to post-survey (see Figure 24). However, the responses show that the majority of teachers used the math software as a supplement to instruction for students of all levels. Again the sub-prompts “In class for students to test their knowledge and determine their learning progress” and “In class to engage some students while I work one and one with others,” appear in the post-survey, but not in the pre-survey. The responses to these prompts indicate that, at least sometimes, teachers used the software as an assessment tool and to provide one-on-one teaching to students.

Pre (N=163)



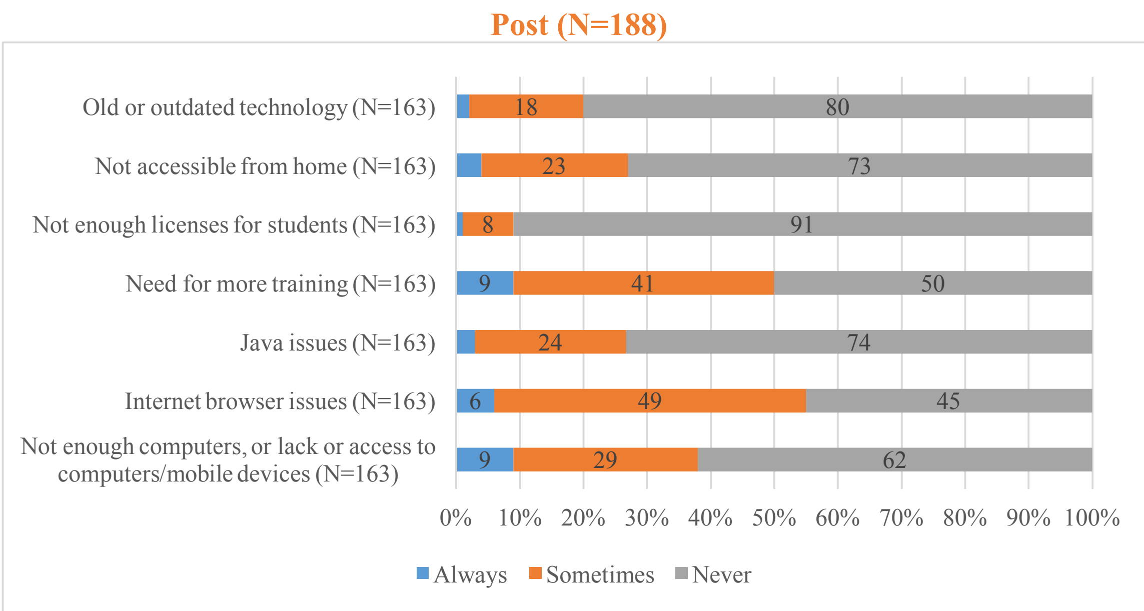
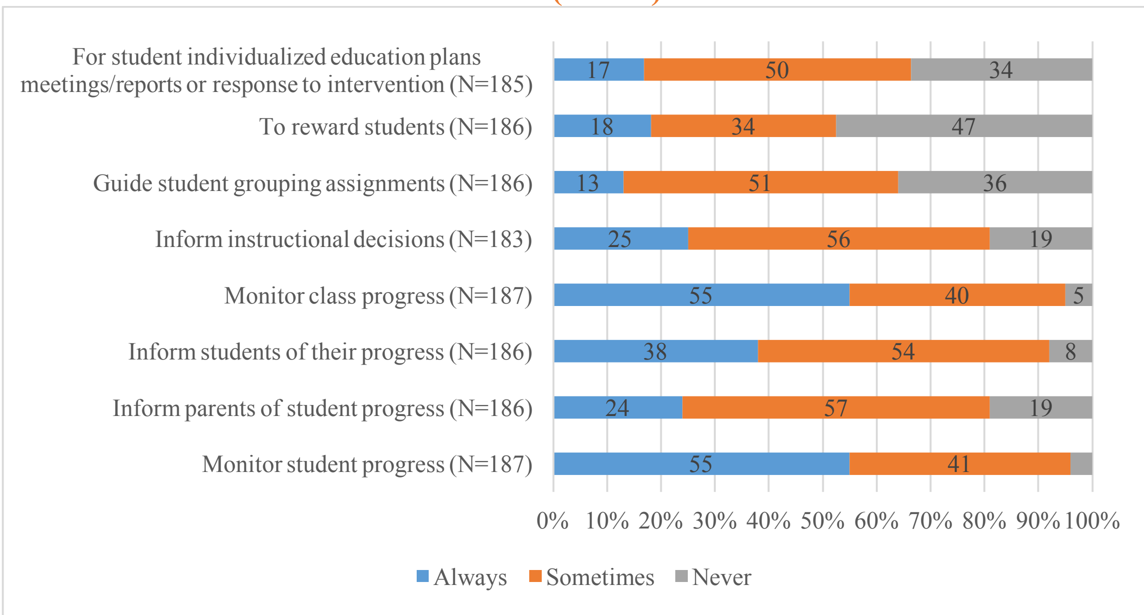


Figure 25. iReady: Describe whether you had any barriers that prevented you from using the product with your students as you would have liked

Similar to the responses seen in the previous product, teachers noted that they sometimes experienced technical issues having to do with their internet browsers (see Figure 25). They also noted that access to technology was an issue, in particular, the need for access to computers. Both of these items are school level issues that may be addressed by the school districts technology team.

Pre (N=163)



Post (N=188)

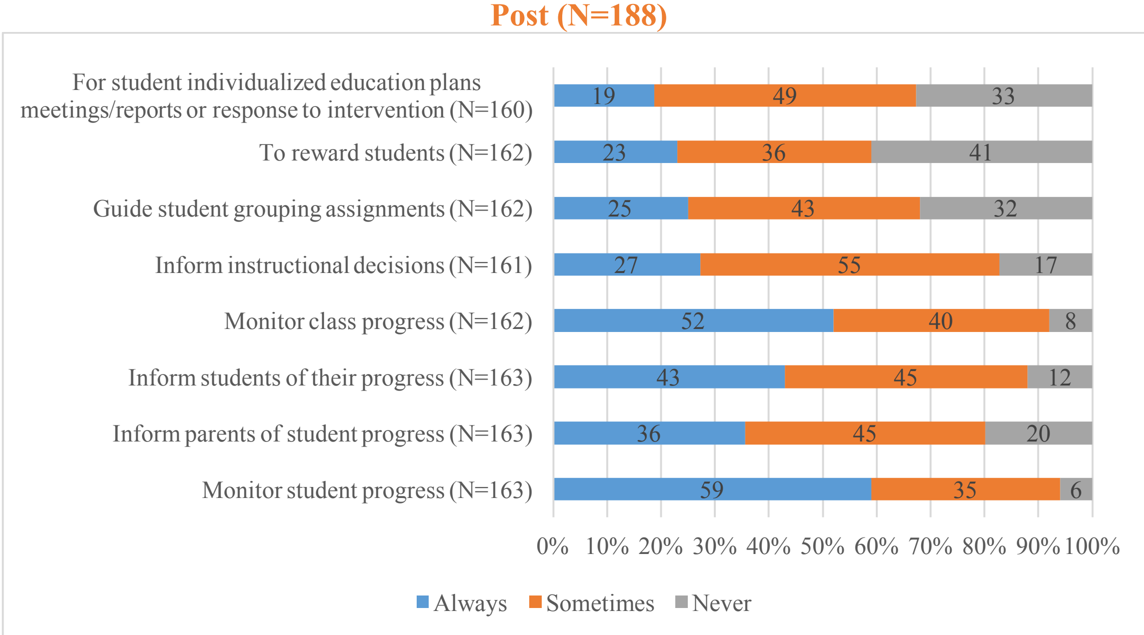
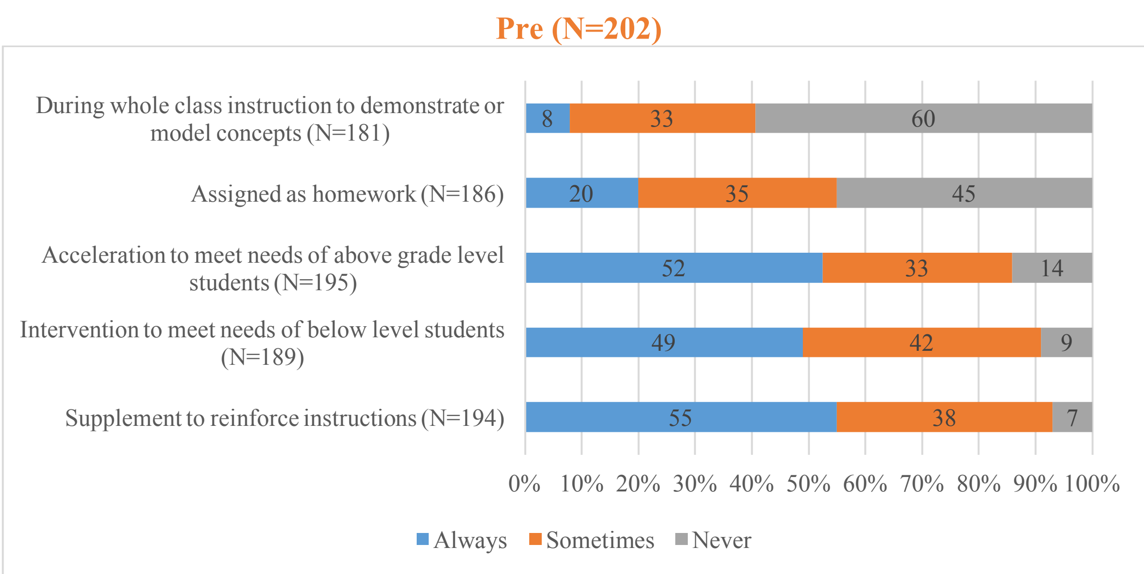


Figure 26. iReady: Please describe how you have been using the data reporting features of the product

While there were no major changes from pre-survey to post-survey, the data describing how teachers used the reporting features in the iReady product show that the majority of teachers used these features in multiple ways to inform their interactions with students (see Figure 26). The prompts with the greatest number of positive responses include “Monitor class progress,” “Inform students of their progress,” and “Monitor student progress.” Each of these responses had more than 90% of responses in the “Always” or “Sometimes” categories. All three of these responses are directly related to assessing students’ progress in their given class. This may imply that the assessment features of the software are positively related to students’ actual progress. Also related to students’ progress, the prompt asking if teachers used the software to “Inform instructional decisions,” implies that teachers used the data on students’ progress to inform their instructional practices.

Think Through Math (TTM)



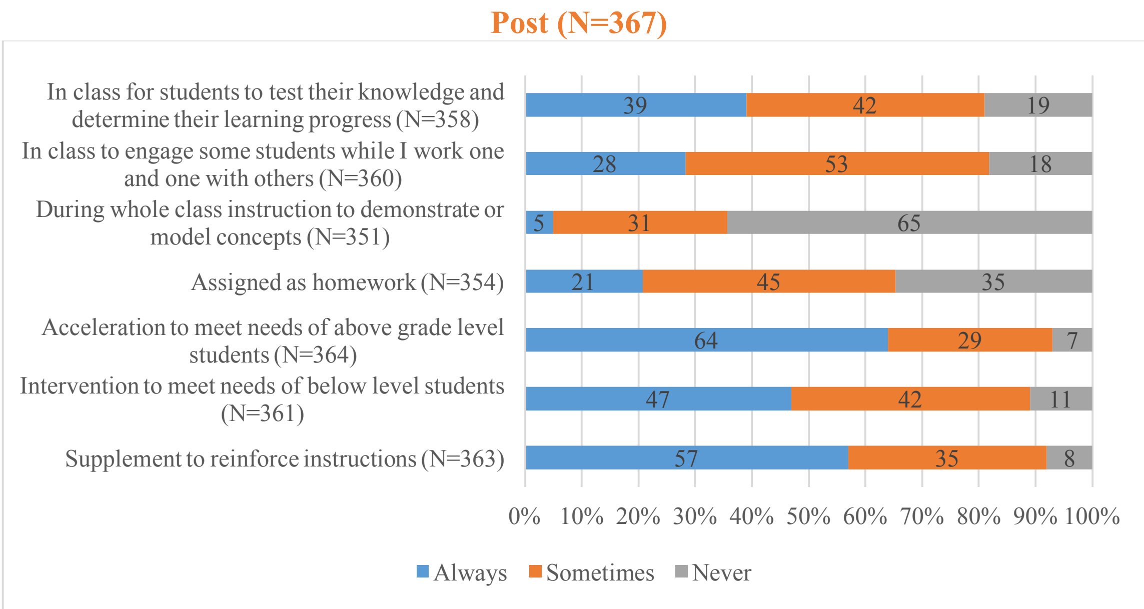
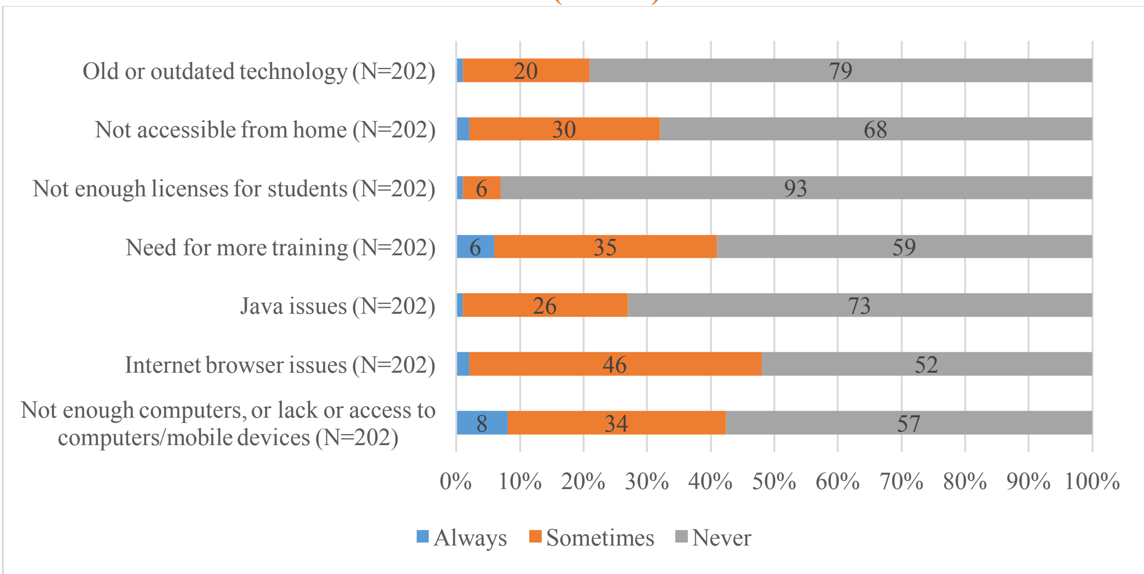


Figure 27. Think Through Math: Please describe how you used the technology product in the last 30 days

The patterns seen in the data describing teachers' responses to the prompt, "Please describe how you used the technology product in the last 30 days," closely mirror those of the products previously described (see Table 27). That is, the math instructional software was used as intervention to meet the needs of students at all levels within the class. For Think Through Math, the largest percentage point gain (a 12-point gain) was in teachers' use of the software to accelerate students' learning who were above grade level. For consistency, we note here that the prompts "In class for students to test their knowledge and determine their learning progress" and "In class to engage some students while I work one and one with others," appear in the post-survey, but not in the pre-survey. These prompts show that the majority of the teachers used the product for intervention, but also to assess students' progress.

Pre (N=202)



Post (N=367)

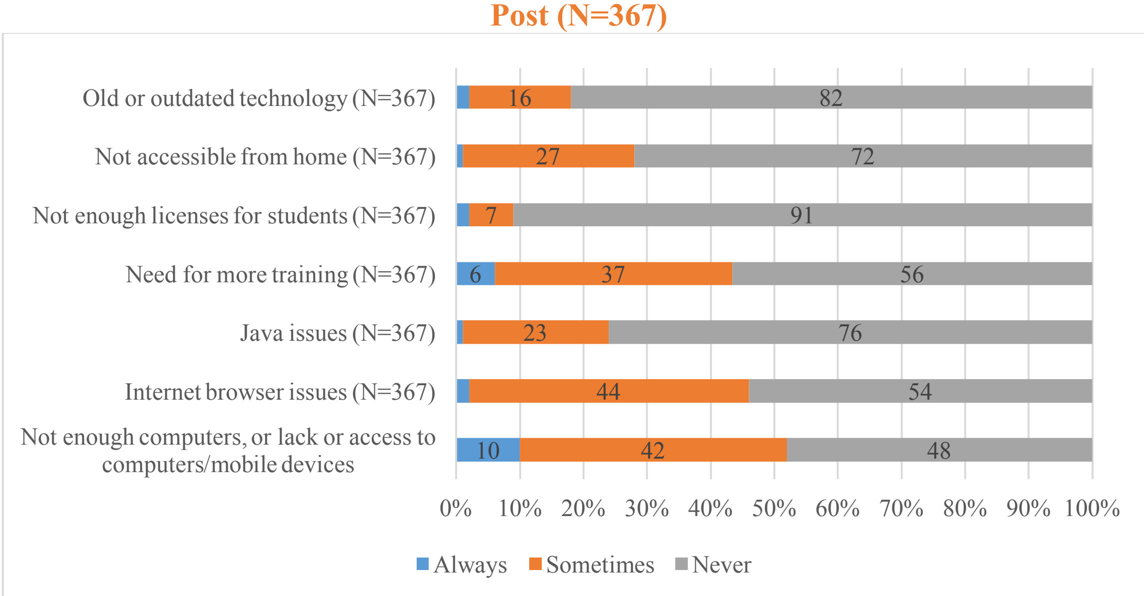


Figure 28. Think Through Math: Describe whether you had any barriers that prevented you from using the product with your students as you would have liked

Similar to the previous products, the barriers that teachers encountered were largely unrelated to the mathematics instructional software product (see Figure 28). Again the categories with the most responses are technology accessibility, internet browser issues, and a need for more training. The technology issues may be handled on a district level. Further, teacher training may be handled on the district level or by the vendor. Many vendors state that they are willing to visit schools upon request.

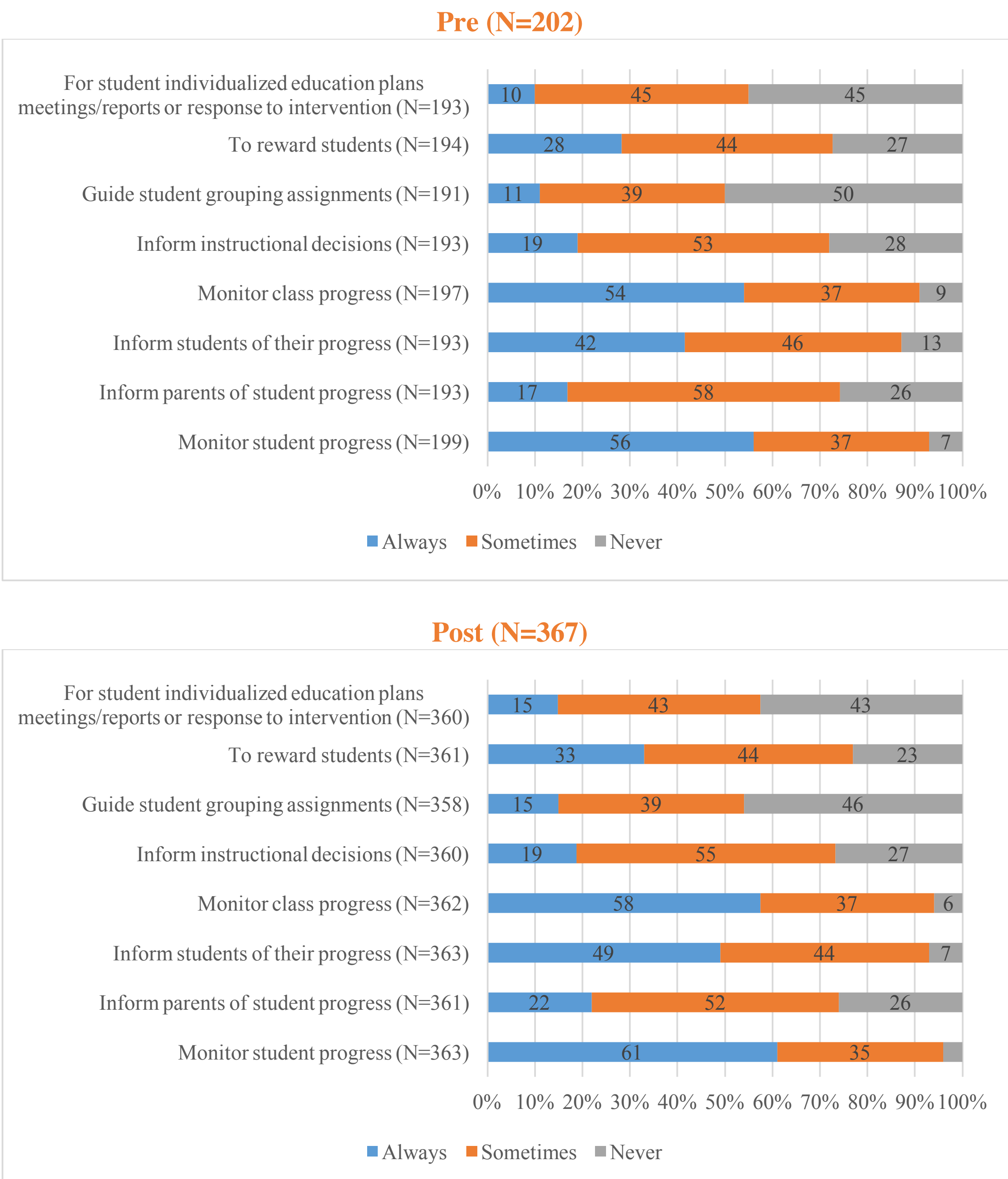
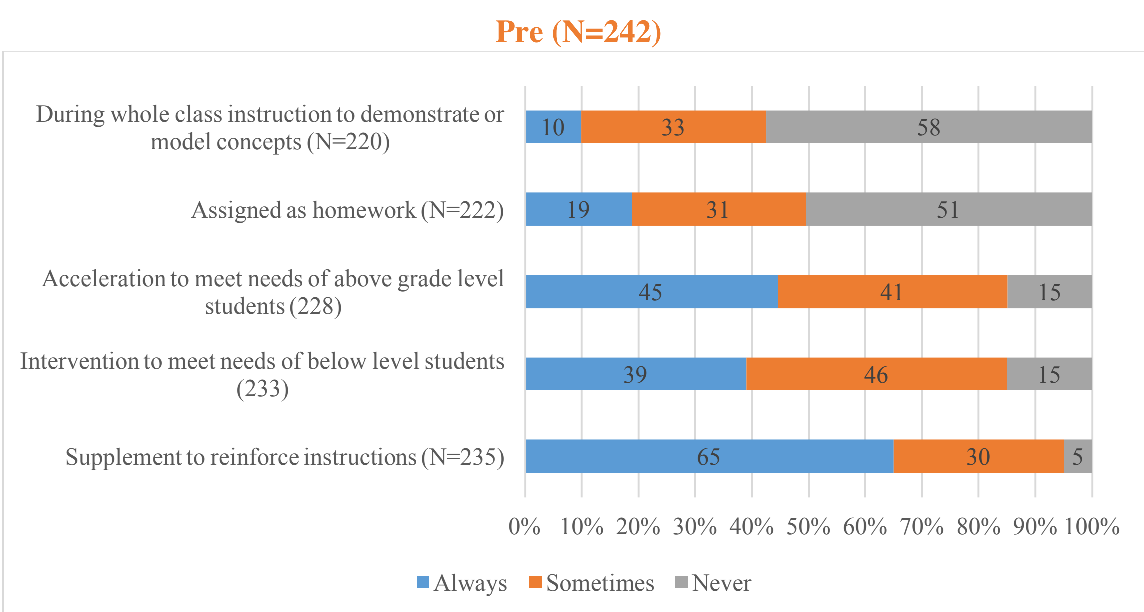


Figure 29. Think Through Math: Please describe how you have been using the data reporting features of the product

Among Think Through Math (TTM) users, there appears to be some stability over time in how respondents are using the data reporting features of the product (see Figure 29). Monitoring student progress seems to be a prevalent form of use, with over half stating that they always use the software for this purpose. Using TTM as a "guide to student grouping assignments" seems to be a less popular way of using the reporting features, with roughly 50 percent of the pre and post respondents claiming they never used the software with that objective. It should be noted that "grouping assignment" may have an ambiguous interpretation. It could be referring to the practice of grouping students who have similar academic achievement levels, which has been a controversial topic in the education research literature (Loveless, 1998). It could also refer to a careful grouping that maximizes the variation in academic achievement among group members. Since the software is used extensively for monitoring student progress, it may be useful to investigate teachers grouping methods and how the software might facilitate positive student groupings.

ST Math



Post (N=441)

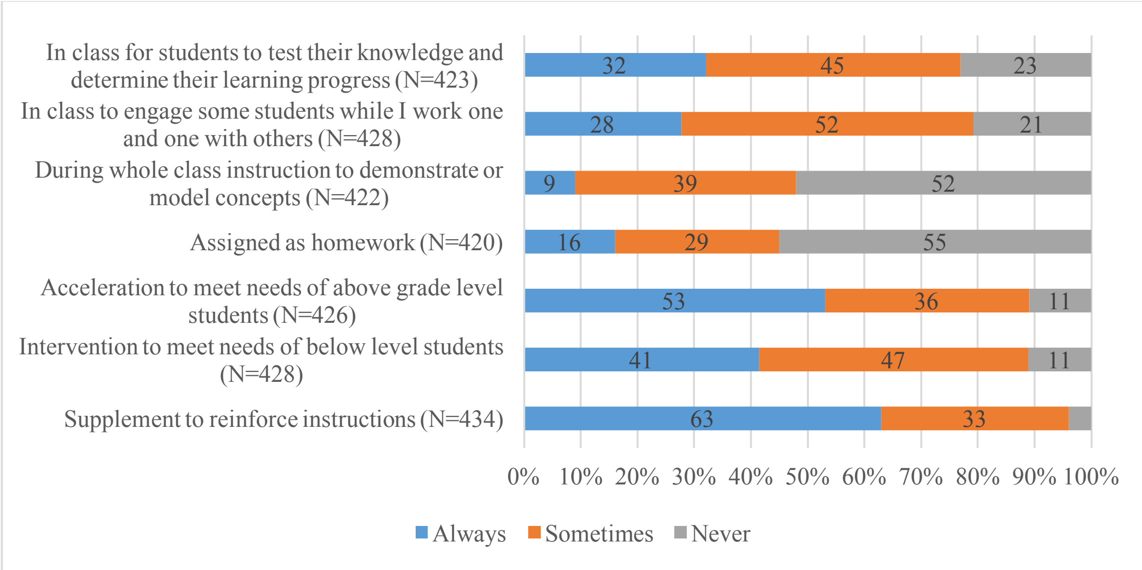
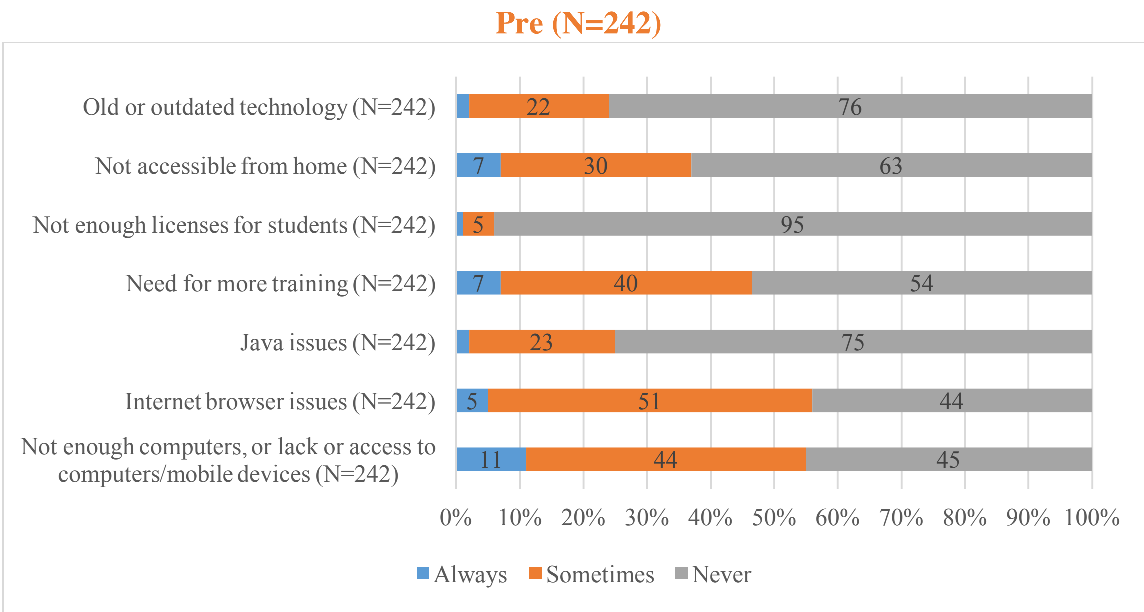


Figure 30. ST Math: Please describe how you used the technology product in the last 30 days

As can be seen in the table above, two additional questions were included in the post-survey that were not included in the pre-survey. Figure 30 indicates that the majority of teachers used the math instructional software for some type of intervention, which is in alignment with the aims of the math instructional software grant program. These interventions include accelarating students who are above grade level, intervention for students below grade level, and supplementing instruction for students in general. Given that only 5% of respondents state that they never use ST Math in a supplemetary way, we are confident in saying that ST Math is primarily being used as a supplement to instruction.



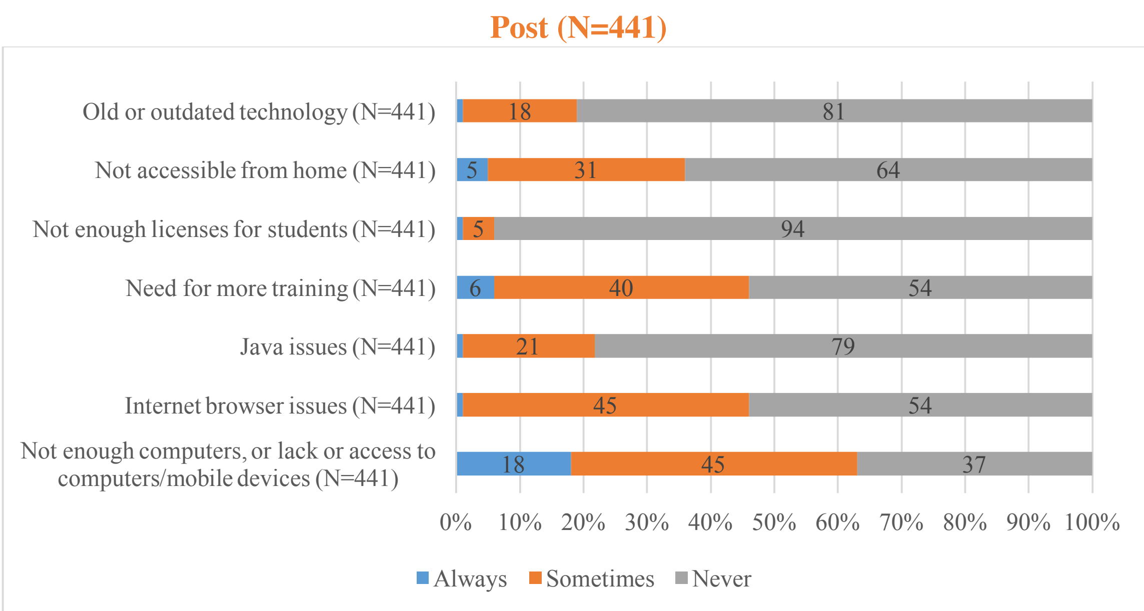


Figure 31. ST Math: Describe whether you had any barriers that prevented you from using the product with your students as you would have liked

We observe relatively minor differences between the pre and post-surveys in the number of respondents indicating barriers to software use; however, there was a 7 percentage point increase in the number of respondents claiming that they did not have adequate access to computers or other devices (see Figure 31). This is consistent with the responses obtained from the open ended questions that will be discussed later. In addition to computer access, a number of teachers noted that other technology issues (i.e., internet browser issues) posed a barrier to software use. There does not appear to be any large reductions in the number of teachers stating that they need more training, which may suggest the need for more frequent training throughout the year.

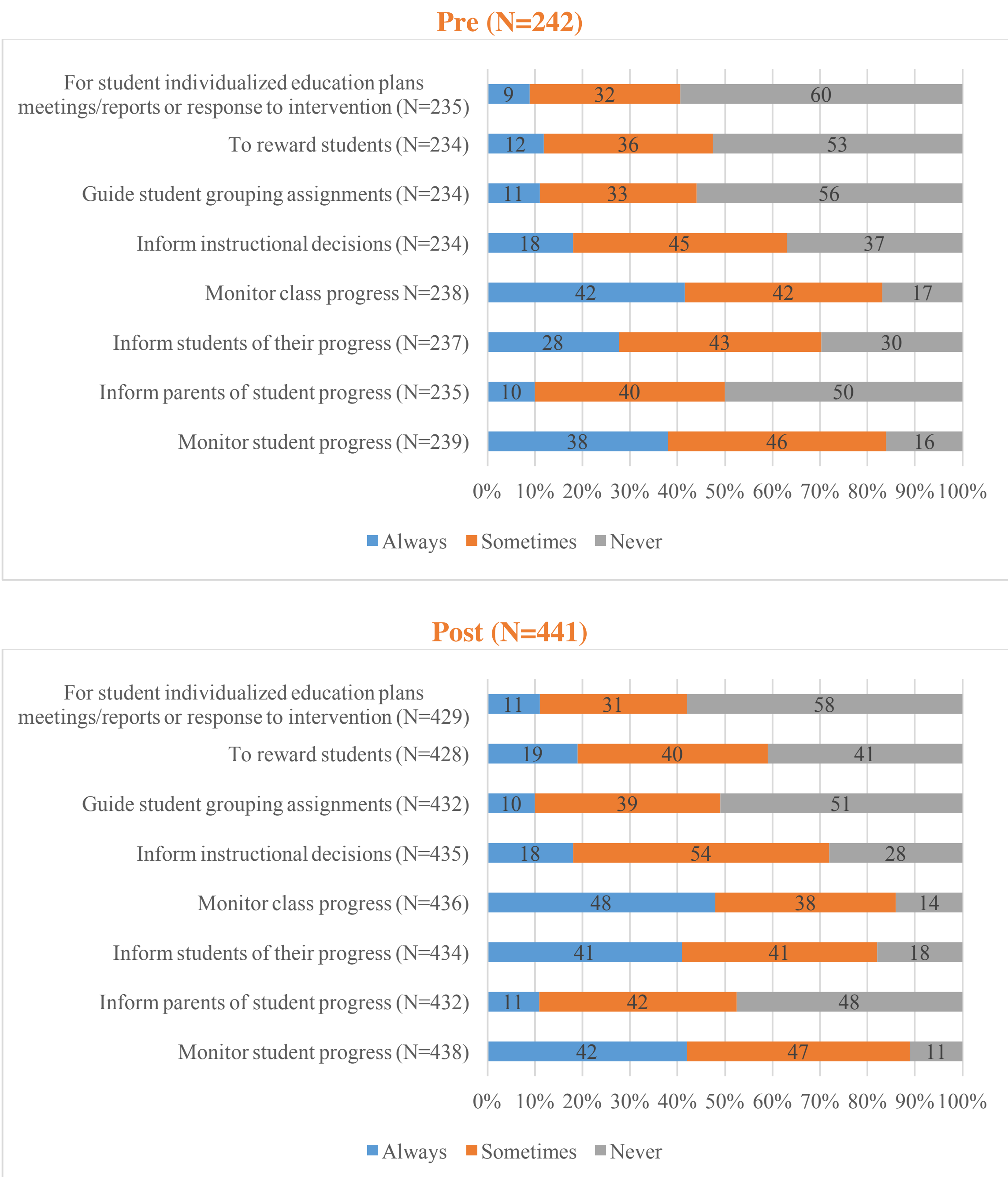
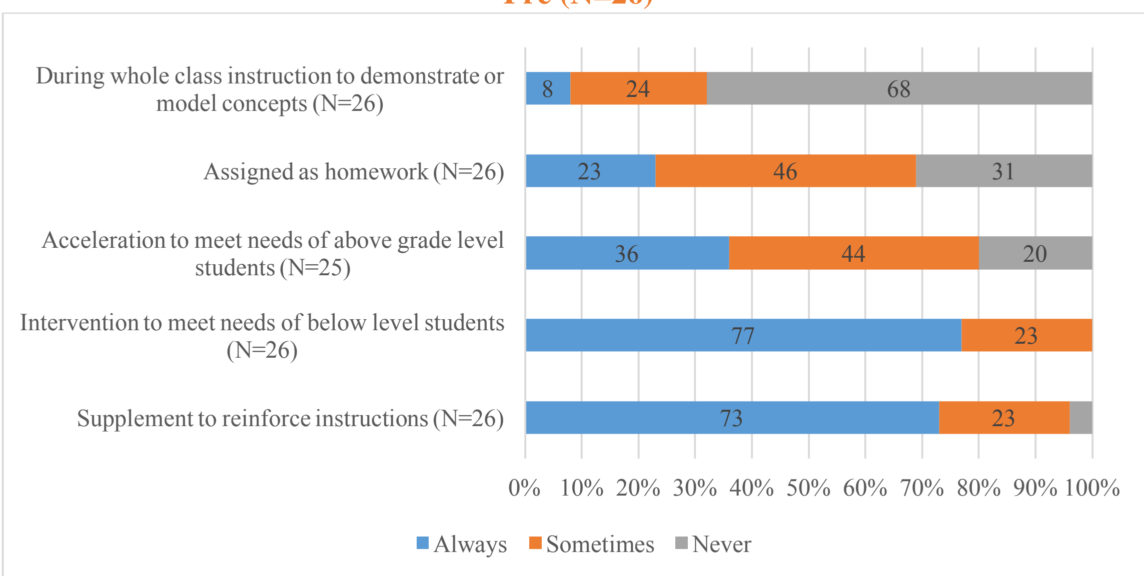


Figure 32. ST Math: Please describe how you have been using the data reporting features of the product

One of the most significant changes between the pre and post-surveys was a 13 percentage point increase in the number of teachers responding that they "always" use the data reporting feature of ST MATH to inform students of their progress (see Figure 32). With this exception, we find a general stability between the pre and post-surveys within each response category. In the remaining prompts, most teachers responded in the "always" and "sometimes" categories, indicating that teachers used the software for progress monitoring. Thus, this stability between pre and post-surveys shows that teachers consistently use the software reporting features to monitor student progress.

Reflex

Pre (N=26)



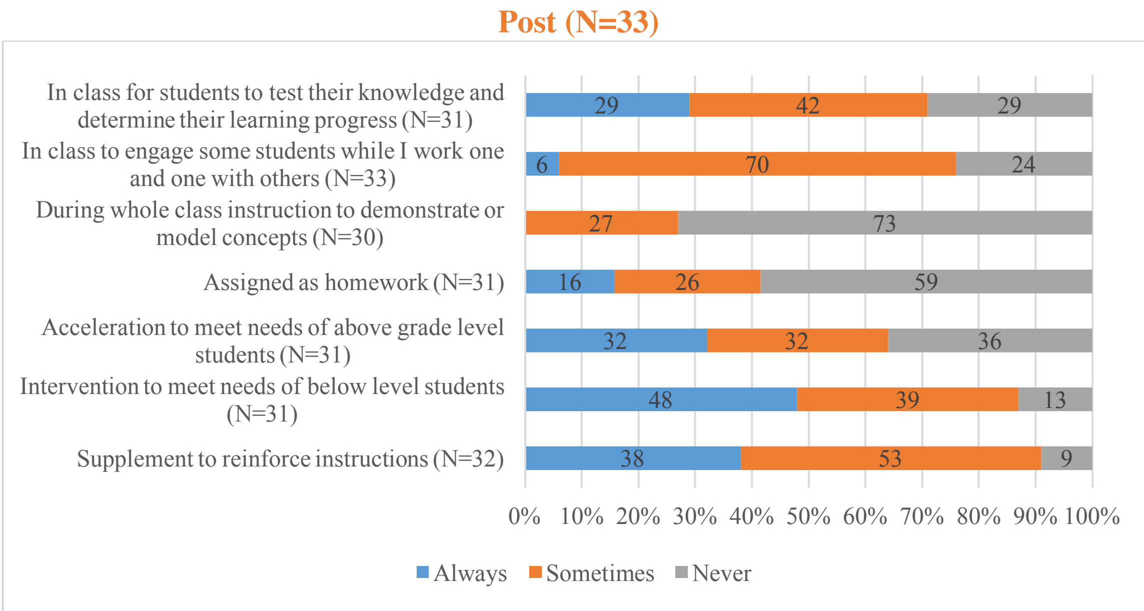


Figure 33. Reflex: Please describe how you used the technology product in the last 30 days

At first glance the response composition to the prompt "Please describe how you used the technology product in the last 30 days" has substantial change between the pre and post-surveys (see Figure 33). However, this may be due to a small sample size on both pre and post-surveys, since each prompt received at most 33 responses for the Reflex math software. Regardless of this limitation, it appears that the general composition of this table is comparable to the other software. In particular, it appears the software was used as a supplement to instruction.

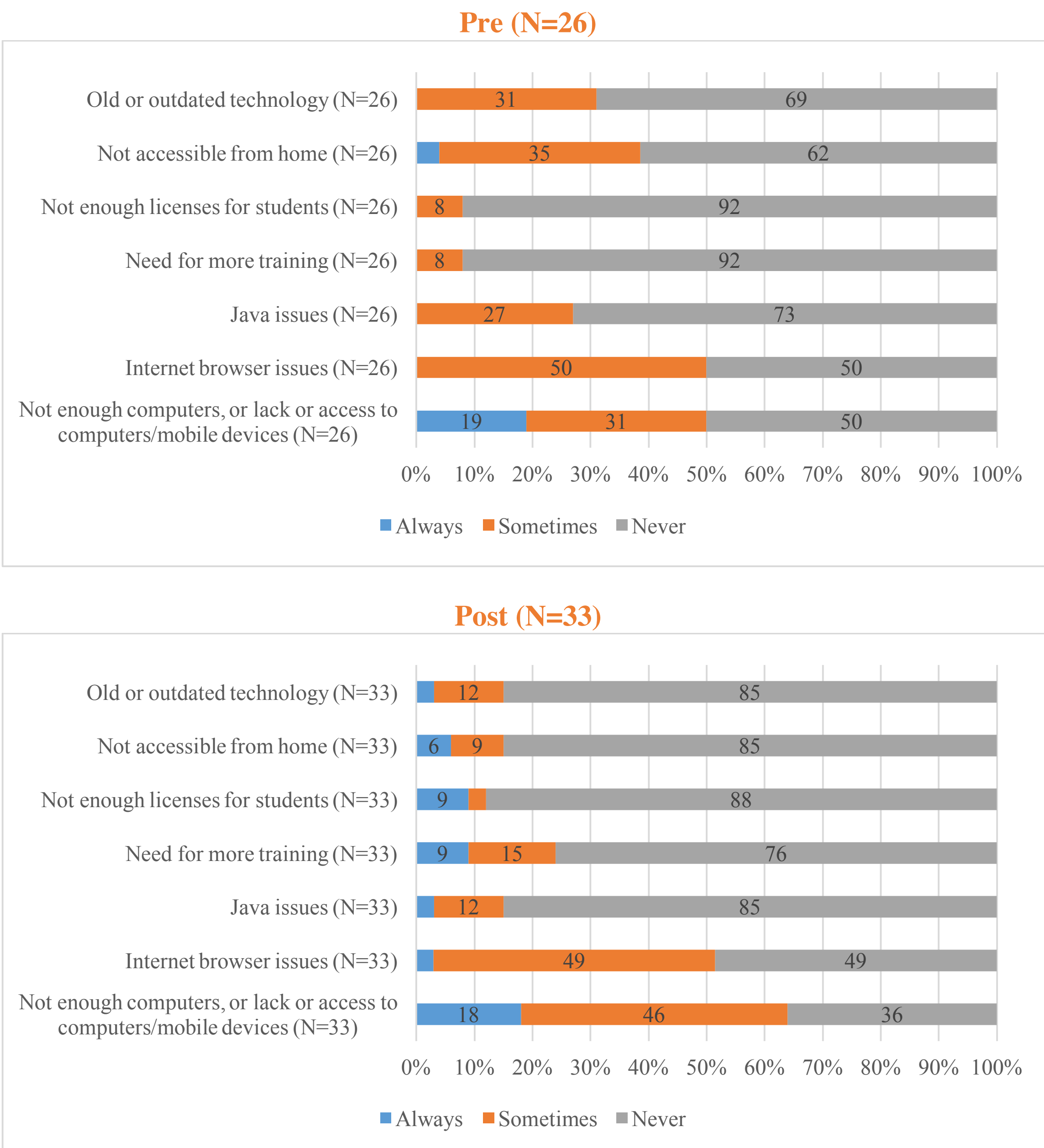
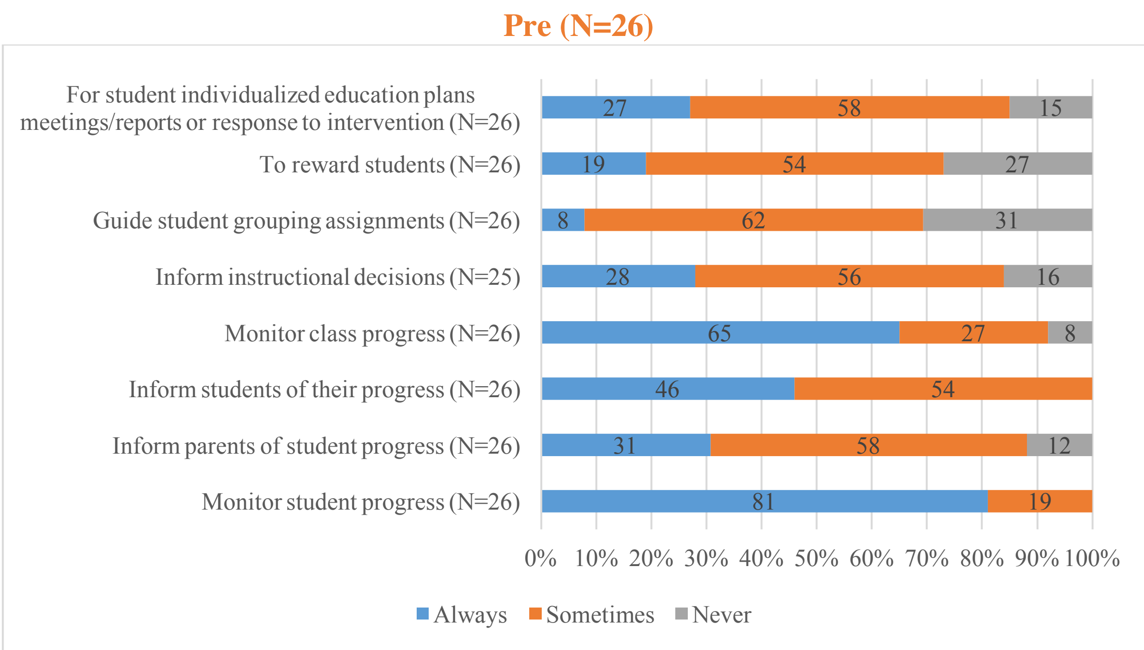


Figure 34. Reflex: Describe whether you had any barriers that prevented you from using the product with your students as you would have liked

Despite small sample size, the trends in responses appear to be similar to that of the other software products. In particular, there are relatively minor differences between the pre and post-surveys in the number of respondents indicating barriers with the software (see Figure 34). Those that did indicate barriers noted that that computer access and internet browser issues were of most concern. The majority of responses indicate that teachers experienced relatively few barriers resulting from the software.



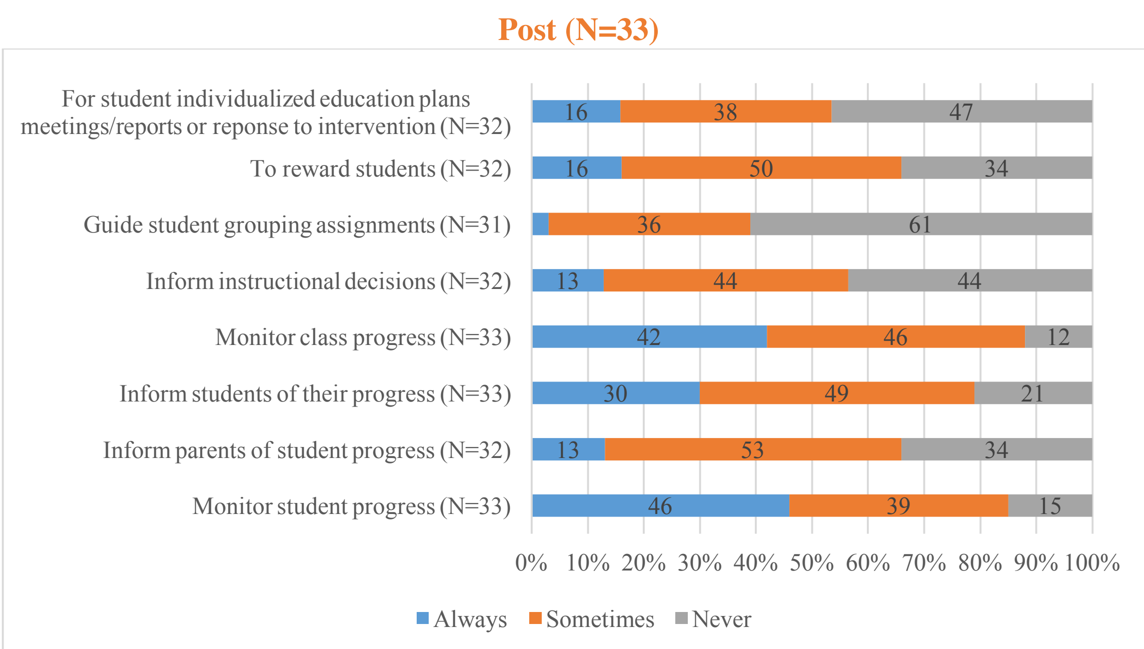


Figure 35. Reflex: Please describe how you have been using the data reporting features of the product

While there are noticeable decreases across most sub-prompts between the pre and post-surveys for “Please describe how you have been using the data reporting features of the product,” these may be attributed to small sample size (see Figure 35). In general, the trends across these data follow those of the previous software. Namely, teachers are using the software to inform them of student progress. In contrast to the previous software, a higher percent of teachers responded that they use Reflex math to inform individualized education plan (IEP) meetings.

Math XL

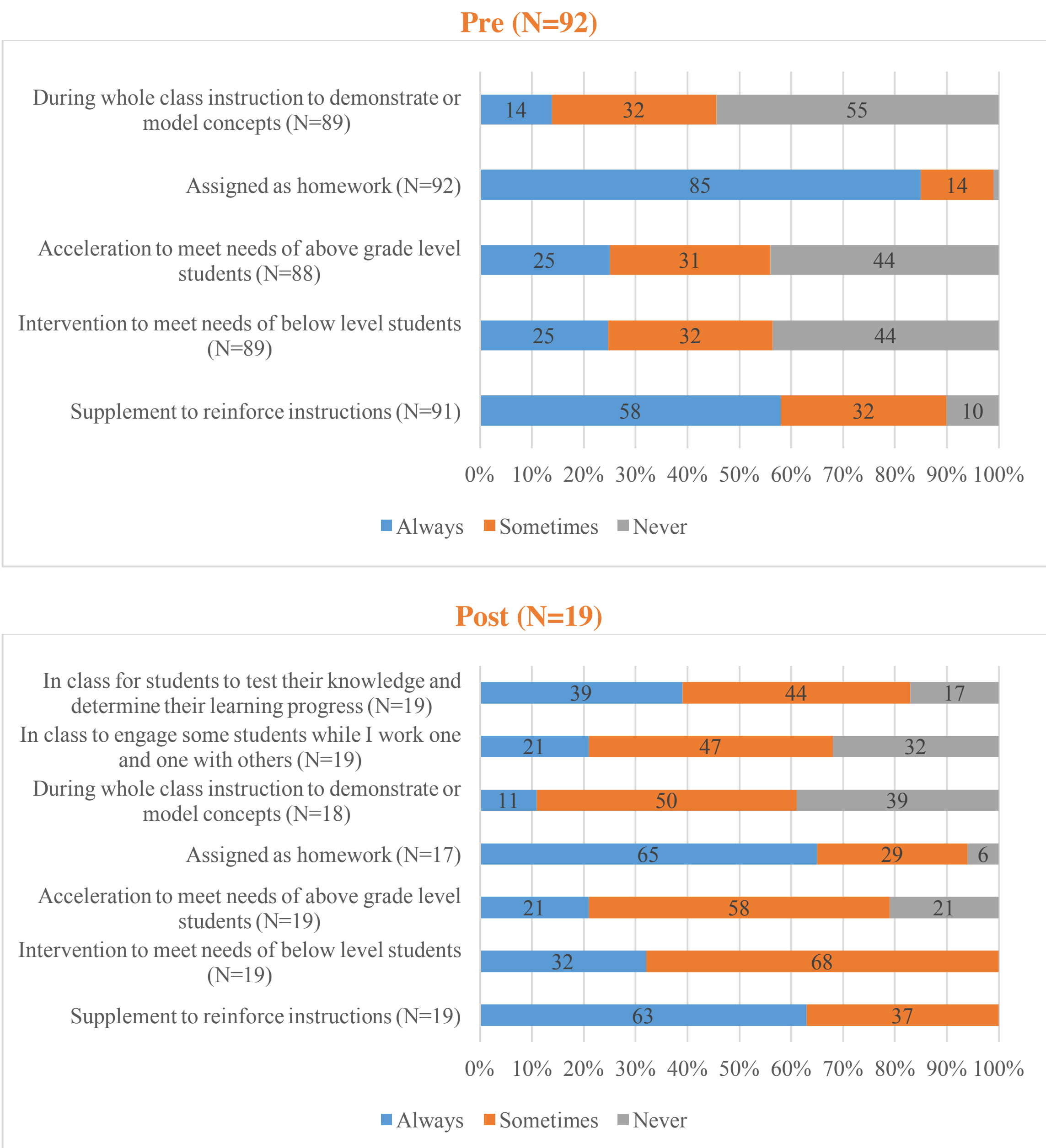
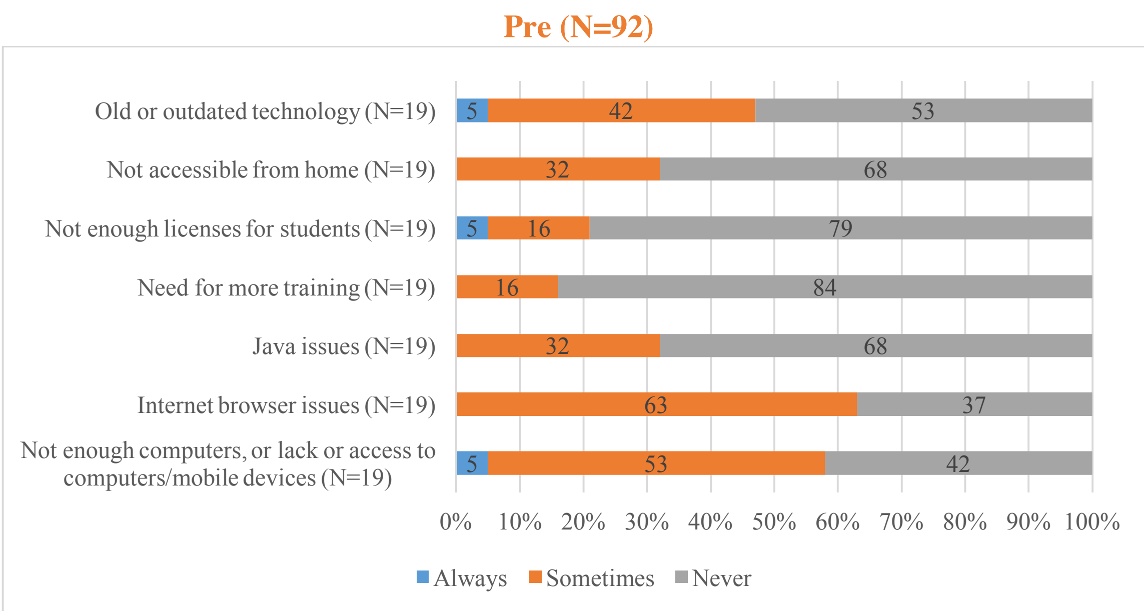


Figure 36. Math XL: Please describe how you used the technology product in the last 30 days

Similar to Reflex math, there were fewer responses to each prompt on the post-survey (N < 20) for Math XL in comparison to the other software products (see Figure 36). In contrast, the pre-survey had a larger response rate (N > 88). Thus, caution should be exercised when interpreting the changes from pre to post-survey. Despite these limitations, a large percent of teachers responded that they used Math XL to supplement instruction. This is consistent with the survey responses for each of the other software products. The most prominent change is a 44 percentage point increase in the number of respondents stating that they use the software as an "intervention to meet needs of below level students." The survey data suggests that most teachers have used Math XL to assign homework, which is consistent with the products design.



Post (N=19)

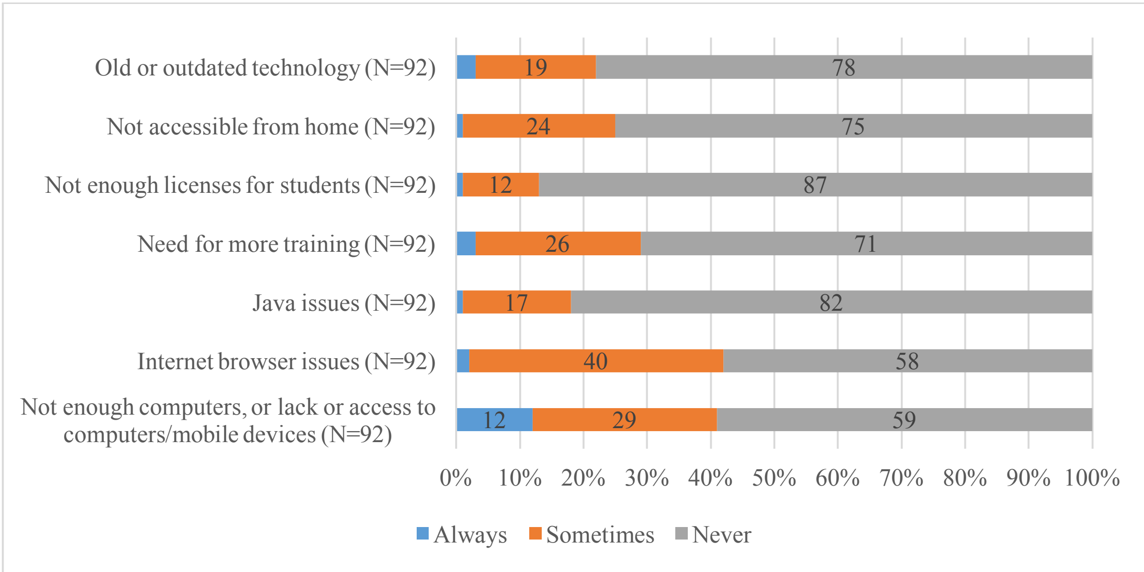
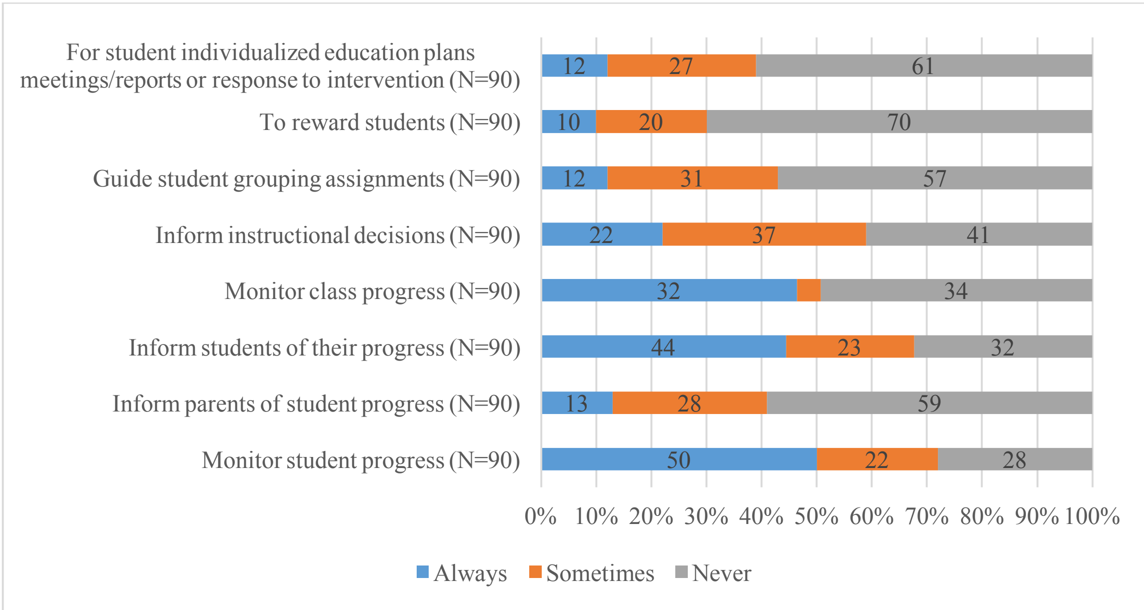


Figure 37. MATH XL: Describe whether you had any barriers that prevented you from using the product with your students as you would have liked

The prompt, "Describe whether you had any barriers that prevented you from using the product with your students as you would have liked," follows trends seen the previously described software products (see Figure 37). Specifically, teachers noted barriers to technology access and internet browser issues.

Pre (N=92)



Post (N=19)

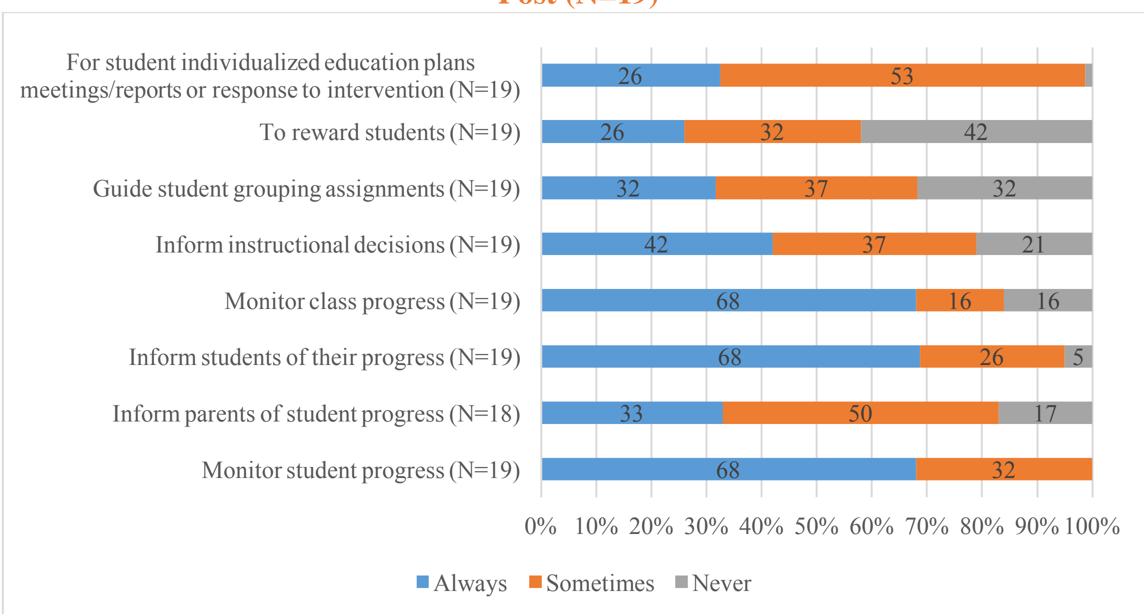


Figure 38- MATH XL: Please describe how you have been using the data reporting features of the product

As seen in Figure 38, there is an increase between the pre and the post-survey results in most of the eight data response categories. This increase in response percentage may be due to the small sample size in the post-survey. Despite these limitations the majority of teachers reported that they used the software to monitor student progress in both the pre and post-surveys.

Qualitative Results

At both the beginning and end of the 2015-2016 school year, teachers in Utah were asked to respond to the following three prompts regarding the software currently used in their classrooms.

- Describe your overall satisfaction with the technology product
- Describe any other barriers that prevented you from using the product
- Describe any other ways you have been using any of the data reporting features of the product

The main difference between the two surveys was the composition of teachers responding. The pre-survey included both teachers that had previously used the educational software and those who had not; whereas, the post-survey only included teachers that had using the educational software over the course of the academic year. The methodology used in this sub-section is the same as that employed in the previous student qualitative open response section. The differences between the pre and the post-surveys appear to be small, with most of the post-survey responses lying within a few percentage points of the pre-survey.

The purpose of conducting both a pre and post-survey is to identify aspects of the instructional software (or its implementation) that teachers consistently find either useful or frustrating. This information could be used to prioritize efforts to improve technological instruction in the future. The open response prompts were included as an open forum where teachers could more freely describe their satisfaction or dissatisfaction with the software selected by their LEA. This subsection is broken down into three segments, one for each prompt provided to the teachers.

Prompt 1: Describe your overall satisfaction with the technology product

Table 23 provides an overview of the type of responses that were given to the prompt "Describe your overall satisfaction with the technology product". The simplest and most straight forward way to initially categorize these comments, was to classify each as either positive, negative, or neutral. The percent of responses between the pre and post-survey seems comparable, with the most notable change being a 2.74% percentage point increase in positive comments in the post-survey.

	PRE		POST	
Type of Comment	**N**	**As Percent of Total Comments**	**N**	**As Percent of Total Comments**
Positive	350	75.59%	253	78.33%
Negative	101	21.81%	67	20.74%
Neutral	12	2.59%	3	0.93%
	Total=463		**Total =232**	

Table 23. Describe your overall satisfaction with the technology product

After the initial positive, negative, or neutral categorization, it became informative to break down the comments further to find out the specific aspects of the software the teachers found either valuable or frustrating. Table 24 breaks down the composition of positive comments into fifteen categories. The largest category "Non-specific expression of satisfaction with the product" means that the response provided was not specific to which aspects of the software they found useful. Responses in this category were generally along the lines of "I love it" or "I am satisfied with the product." The smallest category obtained from the pre-survey was "Informs Instruction" which can be interpreted as indicating that the teacher modified their classroom instruction after receiving the assessment data provided by the software.

	PRE		POST		
Category	**N**	**As Percent of Total Comments**	**N**	**As Percent of Total Comments**	**Representative Comment**
Non-specific expression of satisfaction with the product	13 9	30.02%	93	28.79%	"I am satisfied."

Student success or positive experience	44	9.50%	13	4.02%	“My students have enjoyed challenging themselves and I truly believe it is an asset”
Learning is adaptive and individualized for students	42	9.07%	38	11.76%	“I also like that each student is doing lessons on their own level, so that my higher kids are not being held down and my lower kids aren't in over their heads.”
Students are engaged when using technology	24	5.18%	7	2.17%	“It's fun and engaging”
Develops student’s knowledge or skills	22	4.75%	10	3.10%	“I mostly like this program because it makes students know the "how" and "why" they are doing”
Reinforces or supplement classroom instruction	20	4.32%	34	10.53%	“It is neat when we will be discussing something in math and a student will indicate that STMath had taught them”
Optimistic about potential	15	3.24%	2	0.62%	“It would be a shame to quit using it now when we are just realizing its true value”
Aligned with state standards	13	2.81%	4	1.24%	“reinforces our core”
Provides feedback to students	8	1.73%	0	0.00%	“Being able to retry similar problems is helpful and more instructive than marking answers as incorrect and not finding out why”
User friendly	6	1.30%	8	2.48%	“ST math is great and user friendly!”
Provides information in reports about student’s progress	5	1.08%	19	5.88%	“Gives me a good idea of the level of understanding for most students.”
Provides greater access to teacher help	4	0.86%	4	1.24%	“I love that I can have them engaged on something productive when I need to be able to pull for one-on-one testing.”
Provided variety to math instruction	3	0.65%	6	1.86%	“and it gives an alternative way to teach and demonstrate concepts and mathematical relationships.”

Teacher can customize instruction	3	0.65%	15	4.64%	"I also love that it is individualized. It helps provide interventions"
Informs instruction	2	0.43%	2	0.62%	"I like that it groups my students and let me know where their lacking and what I can help them with."

Table 24. Breakdown of Positive Comments

A breakdown of the negative comments was completed in a similar fashion. The largest change from pre to post-surveys was a reduction in respondents expressing dissatisfaction with support (see Table 25). Given the size of the reduction, we may conclude that the availability of support between the pre and post periods had significantly improved, however, sampling variation in the data may explain this change.

	PRE		**POST**		
Category	**N**	**As Percent of Total Comments**	**N**	**As Percent of Total Comments**	**Representative Statement**
Dissatisfaction with support	19	4.10%	2	0.62%	"I am new to ST Math and am still getting used to how it works and how to manage it for my students. I would like some extra training on reports to use to analyze student data and how to take ST Math in the right direction afterwards."
Student Frustration or User Unfriendly	19	4.10%	4	1.24%	"Students find this program very difficult. Sometimes even as a teacher I have trouble understanding what's expected from a response. It often becomes "Frustration Through Math.""
Lack of challenge or boring to students	13	2.81%	6	1.86%	"Students who are at grade level or honors find this program to slow to keep their interest."
Technical Issues	13	2.81%	20	6.19%	"The logging in could be made simpler for the children, like a teacher

					list and then then the students get to pick their name off a list."
Non-specific Expression of Dissatisfaction with product	10	2.16%	3	0.93%	"We have had problems"
Little or no use	8	1.73%	2	0.62%	"I have not used it in my classroom yet."
Doesn't align with instruction	6	1.30%	1	0.31%	"A problem that I've encountered on Math XL is that the instructions received from the textbook vary from those received from the teacher"
Reports are not helpful	5	1.08%	2	0.62%	"Also, I don't think the data collected from it is very helpful at all in terms of driving differentiated instruction."
Takes too long	4	0.86%	13	4.02%	"It takes too much time."
School level technology frustrations	2	0.43%	5	1.55%	"The product itself is great, but the technology we have access to does not always support it."
Too Difficult or the Pace is too fast	2	0.43%	7	2.17%	"it is taking students to higher levels and not giving them enough instruction to independently pass the concepts."

Table 25. Breakdown of Negative Comments

Prompt 2: Describe any other barriers that prevented you from using the product

Responses to the question, "Describe any other barriers that prevented you from using the product" provided comparable results, with no large changes between the pre and post-surveys (see Table 26). Access to technology may be a growing area of frustration, with a 5.74% percentage point increase in the number of respondents mentioning this as a problem. Measures have been taken in next year's survey to gauge the difference between the amount of time teachers would ideally prefer to spend with the software, and the amount that their school currently permits.

	PRE		POST		
Category	**N**	**As Percent of**	**N**	**As Percent of**	**Representative Statement**

		Total Comments		Total Comments	
No barriers/No Response	147	50.69%	156	50.81%	“Haven't notice any barriers yet.”
Scheduling or time restraints	38	13.10%	48	15.64%	“Not enough time in my curriculum to fit it in.”
Access to technology	21	7.24%	40	13.03%	“available time due to access to having computers”
Student don't have access at home/no parents support	14	4.83%	20	6.51%	“Students without internet access at home.
School technology specific frustration other than access	13	4.48%	4	1.30%	Just the normal computer issues of the student’s computers being locked up on a question or the program freezing on a screen.”
Need to learn more about the program	12	4.14%	12	3.91%	“I am not familiar with all the features of the software.”
Product specific technical usage difficulties (login)	11	3.79%	3	0.98%	“Students could not access the site for a few weeks.”
Licenses, account and setup	8	2.76%	2	0.65%	“I had to wait to get an account set up so I went a few weeks without my students doing it.”
Internet connectivity problems	6	2.07%	5	1.63%	“Laggy server”
Little or no use	5	1.72%	0	0.00%	“Have not started using”
Student frustrations	3	1.03%	2	0.65%	“The students get very frustrated because our netbooks are so slow and take forever to come on.”
Reports are not helpful	3	1.03%	3	0.98%	“I wish I could see the problems my kids have missed so I know better how to help them.”
Doesn't work across platforms	3	1.03%	0	0.00%	“I would like to be able to use it with iPads.”
Not user friendly	2	0.69%	0	0.00%	“Some of the questions are really hard to understand what it is asking even as a teacher.”

Doesn't aligned to standards	2	0.69%	9	2.93%	"We have so much testing to do and other programs that are more relevant to end of the year testing"
Student boredom/dislike	2	0.69%	3	0.98%	"My students don't love ST math."

Table 26. Describe any other barriers that prevented you from using the product

Prompt 3: Describe any other ways you have been using any of the data reporting features of the product

The last question was, "Describe any other ways you have been using any of the data reporting features of the product." Examining Table 27, we see that there doesn't seem to be drastic changes in the response composition between the Pre and Post-surveys. One of the largest changes was a reduction in the percent of teachers stating that they don't use the product. This suggests that a greater number teachers were using the software by the end of the year. It is possible that the increase in users was due to a higher comfort level with the software product. In order to provide consistency with regards to monitoring the trends in teacher satisfaction with the software, all three questions will be included in next year's survey.

	PRE		POST		
Category	**N**	**As Percent of Total Comments**	**N**	**As Percent of Total Comments**	**Representative Statement**
No Response	162	59.34%	192	61.34%	"None"
Track student usage or progress monitoring	30	10.99%	38	12.14%	"I like to see how the students are progressing"
Little or no use	16	5.86%	4	1.28%	"I haven't taken full benefit of the reports because our students do not have enough information available yet."

Unclear	10	3.66%	1	0.32%	"Nothing makes sense. This is not a good program."
Identify and create targeted interventions	10	3.66%	21	6.71%	"I like the way it informs me of problems the students are having so I can intervene."
Needs more time, information or training	8	2.93%	3	0.96%	"I would be interested in more information on the data available to me through ST math."
Informs instruction	8	2.93%	5	1.60%	"We use this product to help drive instruction in our school."
Reward student performance/ motivation	6	2.20%	3	0.96%	"I reward students as they pass 10 lessons."
General satisfaction with reports	5	1.83%	13	4.15%	"I like the new standards report."
Report student progress to parents	4	1.47%	17	5.43%	"To show parents and students where they are at in math during parent teacher conferences."
Helps teacher group students by ability level	3	1.10%	3	0.96%	"To help decide which groups to put students in for instruction."
Differentiate student's needs	3	1.10%	8	2.56%	"I have used the data to differentiate the needs of the students."
Grades	3	1.10%	4	1.28%	"To help determine overall grade in class."
Testing	2	0.73%	1	0.32%	"Prepare students for computer tests."
Determine whether interventions have been effective	2	0.73%	0	0.00%	"I use it to track IEP goals"
PLC	1	0.37%	0	0.00%	No Example Provided

Table 27. Describe any other ways you have been using any of the data reporting features of the product

Teacher Survey Discussion and Recommendations

Schools who participated in the STEM Action Center (AC) math instructional software grant, completed a grant application process. A requirement of the application, was that schools were to use the math software as a supplement to instruction, and not to replace instruction. The general theme among the survey responses showed that the majority of schools followed this directive. In particular, the majority of teachers responded that they used the software for the following supplementary instruction: accelerate students who were above grade level, intervention for students who were below grade level, and as a supplement to classroom instruction in the form of concept demonstrations. These uses allowed teachers to provide individualized instruction. Student outcomes resulting from this supplemental instruction are evaluated via student SAGE scores in Appendix A.

To direct supplemental instruction, many teachers used the data reporting features to monitor student progress. Teachers then used this data to modify instruction to meet student's needs. One teacher noted that, "I like the way it informs me of problems the students are having so I can intervene." These data reports were also shared with students and their parents to communicate students' progress. The impact of this increased communication between students, parents, and their teachers, help bring a greater awareness of student progress and may provide a way for these individuals to work together toward improving student outcomes.

Although teachers infrequently experience barriers to software implementation, some teachers experienced issues including access to necessary technology and periodic internet browser issues. Neither of these barriers are directly attributed to the software, and may not be addressable by school administration. For example, schools have fixed technology budgets. Thus, if there is a deficiency in the number of computers available to students, and there are no funds to purchase more computers, administrators may not have a way to remove this barrier to software implementation. Thus, it is recommended that alternative paths to purchasing and updating school technology are explored.

Overall teachers were happy with the technology product selected by their local education agency (LEA). Over 75% of teachers responded positively when asked about their satisfaction with the math instructional software. Teachers used the data reporting features to inform their instruction and provided increased communication between students, parents, and teachers, which may improve student outcomes.

References

Brasiel, S., & Martin, T. (2015). *STEM Action Center Grant Program Annual Evaluation Report.* Logan: Utah State University, Department of Instructional Technology and Learning Sciences.

Eccles, J. (2009). Expectancy Value Motivational Theory. Retrieved September 09, 2016, from http://www.education.com/reference/article/expectancy-value-motivational-theory/

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and social psychology bulletin*, *21*(3), 215-225.

Chouinard, R., & Roy, N. (2008). Changes in high-school students' competence beliefs, utility value and achievement goals in mathematics. *British Journal of Educational Psychology*, *78*(1), 31-50.

Leder, G. C., & Forgasz, H. J. (2002). Measuring Mathematical Beliefs and Their Impact on the Learning of Mathematics: A New Approach. In *Beliefs: A hidden variable in mathematics education?* (pp. 95-113). Springer Netherlands.

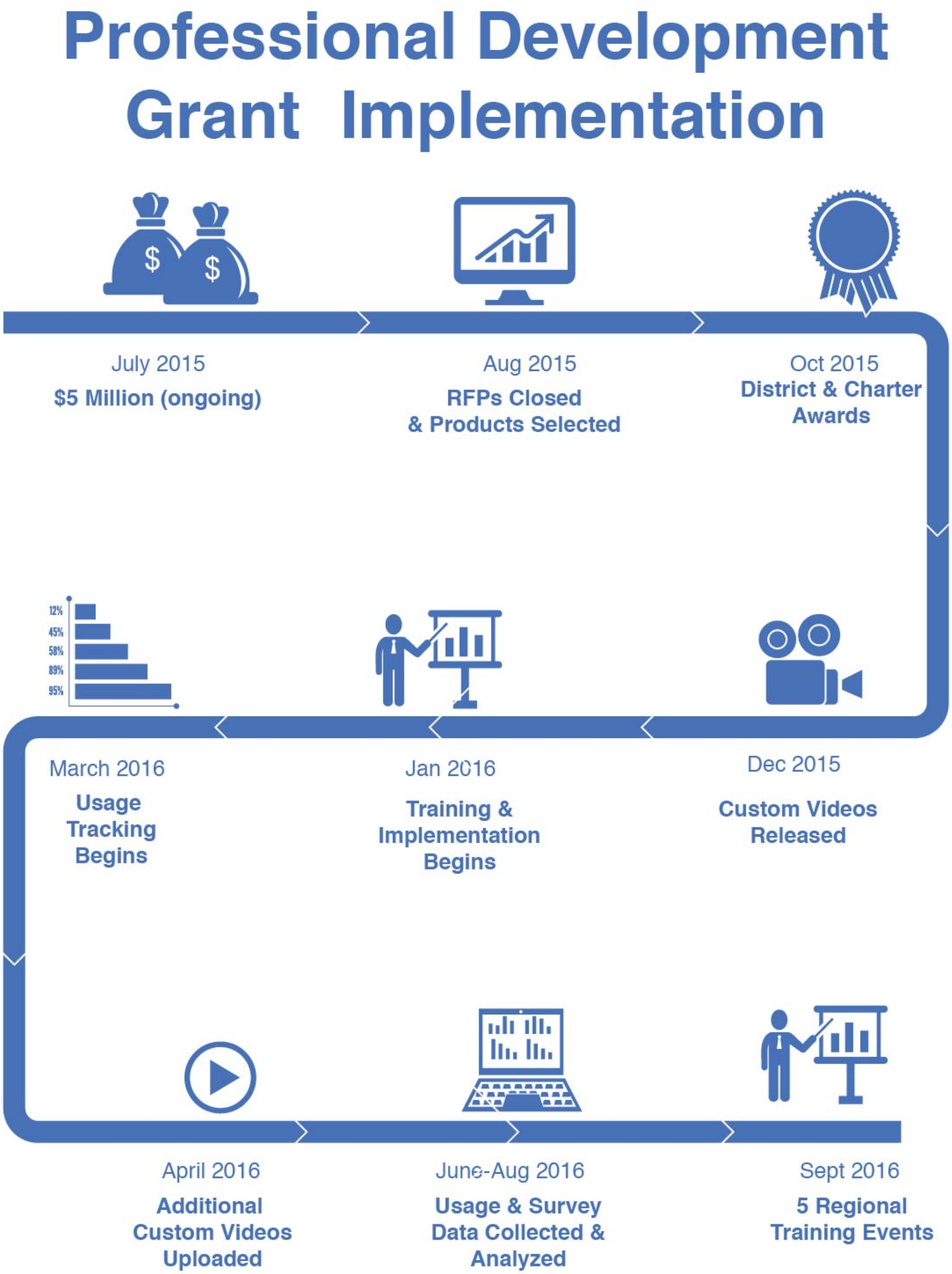
Loveless, T. (1998). *Making Sense of the Tracking and Ability Grouping Debate.* Dayton, Ohio: Thomas B. Fordham Foundation.

Middleton, M. J., Kaplan, A., & Midgley, C. (2004). The change in middle school students' achievement goals in mathematics over time. *Social Psychology of Education*, *7*(3), 289-311.

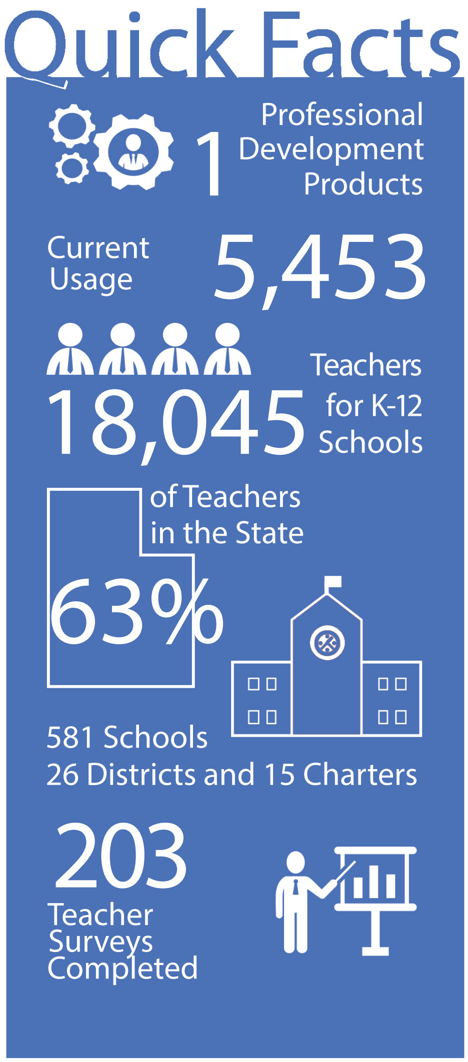
Onatsu-Arvilommi, T., & Nurmi, J. E. (2000). The role of task-avoidant and task-focused behaviors in the development of reading and mathematical skills during the first school year: A cross-lagged longitudinal study. *Journal of educational psychology*, *92*(3), 478.

Watt, H. M. (2000). Measuring attitudinal change in mathematics and English over the 1st year of junior high school: A multidimensional analysis. *The Journal of Experimental Education*, *68*(4), 331-361.

Chapter 3 - Professional Development Grants



Introduction



School Improvement Network (SINET) designed Edivate, an online video based professional development platform. This was the only professional development product distributed to schools through the STEM Action Center (AC) professional development grant program. SINET distributed 18,045 licenses to teachers. This represents 63 percent of teachers in Utah. The teachers represented 26 districts and 15 Charters (581 schools). Based on usage data from the providers, 5,453 teachers logged onto the Edivate platform, accessing videos from many STEM disciplines. The Evaluation team collaborated with the STEM AC to administer surveys to participating teachers, receiving 258 responses.

Professional development (PD) is a critical link between teacher practice, student achievement, and improving instruction (Wei, Darling-Hammond, Andree, Richardson, & Orphanos, 2009); however, many professional development opportunities occur only once, focus on decontextualized information, and do not connect with teachers' perceived needs (Bransford, Brown, & Cocking, 2000). Conversely, studies suggest the most successful professional development efforts occur over extended periods of time and build on procedural research-based knowledge through a collaborative decision-making process

(Bransford, Brown, & Cocking, 2000). Today, there are a variety of technologies which have the potential for providing new possibilities for PD. In particular, many researchers have studied the effectiveness of video-based PD; however, the results have been inconclusive (Fishman, Konstantopoulos, Kubitskey, Vath, & Park, 2013; King, 2002; Lock, 2006). There still remain questions regarding how online PD platforms and hybrid (online and face-to-face) PD may support and enhance teacher practice.

We had the opportunity to examine teacher perceptions throughout various stages of the implementation of Edivate, a professional development (PD) platform created by School Improvement Network (SINET) that offers a collection of on-demand instructional videos covering 125 topics with examples from real classrooms. Videos have been filmed in over 3,500 classrooms, then uploaded to Edivate where they are shared with a network of 1.2 million educators. In addition to videos, Edivate has tools that can be used to create a PD plan where users can set goals, track their learning, and provide evidence of growth (Glasset, Shaha, & Copas, 2015). It is this online PD platform from which we sought to glean insights into teachers' perceptions.

To gain this insight, we collaborated with the STEM Action Center (AC) to distribute surveys to teachers in the Spring of 2016. Their feedback has been used to inform future implementations and use of Edivate across the state during the 2016-2017 school year. The surveys were designed to answer the following research questions:

- With which features of the Edivate product are teachers most satisfied?
- With which features of Edivate, are teachers most concerned?
- What were teacher and administrator's perceptions towards the Edivate product?
- What educational content was frequently accessed by teachers using Edivate?
- What motivated teachers to use or not use the Edivate product?
- What were teacher's outcomes for using Edivate?
- How does partial and fully supported training from the School Improvement?
- Network (SINET) impact Local Education Agencies (LEA) and teacher usage?

There were 18,045 teachers and school administrators given access to Edivate by School Improvement Network. Of these, 258 teachers and administrators responded to the survey. Teacher participation was voluntary, which may explain the small survey response size relative to the total number of grant participants.

Edivate from School Improvement Network Implementation 2015-2106

This evaluation is a preliminary investigation of the implementation of Edivate by School Improvement Network, a professional development platform with high quality videos of instruction, as well as resources and tools to set up professional learning communities where teachers can upload their own videos to share with others. Five primary types of data were collected to gain insight from the implementation of Edivate in Fall 2015: creation of implementation plans, completion of professional development Bootcamp by district and charter leaders, delivery of licenses, usage of online platform, and administration of a survey of teacher perceptions of the platform and professional development received.

For the 2015/2016 academic year, the STEM Action Center awarded licenses to Schools and Districts in June, 2015. Training began in July and August 2015. The STEM AC also contracted with SINET to create high quality videos of teachers in Utah. These videos were aligned to the Utah Core Standards. Video production began around September 2016; however, as SINET did not provide a method for discerning uploaded videos created by Utah teachers, no video data was collected.

Cumulative usage data was furnished by SINET from August 2015 to May 2016. Participating Cactus IDs were collected in April/May 2016. These teacher IDs were collected to be merged with teachers' usage data. This data was to be sent to USBE to be merged with participating teachers' students' SAGE data. However, due to low usage, data obtained from

SAGE assessments would not be a reliable measure of student outcomes. This is in large part because a representative sample of students whose teachers had significant Edivate usage could not be assembled. We anticipate an increase in usage during the 2016-2017 academic year, which will provide for reliable analysis of students' SAGE scores.

District or Charter	# of licenses requested	# of licenses delivered
District		
Alpine	1,182	1,271
Beaver	94	98
Cache	815	996
Canyons	2,000	2,127
Carbon	225	228
Daggett	15	32
Davis	4,100	3,217
Granite	1,000	1,926
Iron	44	156
Juab	114	117
Logan	300	289
Murray	375	346
Nebo	1,493	976
North Sanpete	160	427
North Summit	63	67
Park City	330	341
Piute	35	41
Provo	840	801
Rich	38	60
S. Sanpete	220	232
San Juan	300	222
South Summit	98	108
Tintic	12	34
Wayne County		63
Weber	1,800	1,788
Washington	1,800	1,957
Total	**17,453**	**17,920**
Charter		
Beehive Academy for Science	21	24

and Technology		
CS Lewis Academy		25
Davinci Academy		
Excelsior Academy	34	34
Mana Academy		48
Moab Community Charter		15
Monticello Academy	50	45
Noah Webster Academy	3	38
NUAMES Academy	38	42
Pinnacle Canyon Academy	38	50
Providence Hall	150	124
Quest Academy		81
Salt Lake Center for Science Education		29
Summit Academy- Bluffdale Elem	86	86
Summit Academy- Elem	150	50
Summit Academy- HS	35	35
Syracuse Arts Academy	35	51
Utah Schools for the Deaf & Blind		241
Multi-district implementation meetings		
Total	**640**	**1,018**
TOTAL	**18,093**	**18,938**

Table 28. District and Charter License Distributions

In Table 28, we provide the number of Edivate PD licenses requested and distributed to the Utah LEAs. What follows is a description of the different kinds of training and implementation support offered by SINET to support implementation of the Edivate platform.

BLUEPRINT FOR SUCCESS

District and school administrators prepared for implementation of Edivate through the Blueprint for Success training course. This academic year, 482 teachers attended the Blueprint for Success Training, which was an increase of 125 from the previous year's attendance of 357 teachers. School Improvement Network (SINET) offered these trainings as a one-day onsite training and recommended that leaders take the Edivate Essentials Course first as a prerequisite. The training, based upon principles from the Implementation Framework, empowers administrators to integrate Edivate into their professional development strategy and plans by guiding them through the development of a systematic approach to professional development, helping them to draft an action plan specific for their schools, and discuss communication strategies that increase overall adoption and use. In Table 29, we provide an overview of the number of participants, along with the number of participation days, by district and charter for the Blueprint for Success course.

District or Charter	# of Participants	Days
District		
Alpine	31	6
Beaver	6	1
Cache	16	1
Iron	8	1
Murray	11	1
Nebo	22	1
Piute	23	2
Weber	76	4
Washington	275	9
Total	**468**	**26**
Charter		
Davinci Academy	7	1
Monticello Academy	7	1
Total	**14**	**2**
TOTAL	**482**	**28**

Table 29. Blueprint for Success Participants and Number of Days by District and Charter

BOOT CAMP

SINET either hosts this two-and-a-half day professionally facilitated experience at the School Improvement Network's headquarters in Salt Lake City, or regionally near the school district or charter school. In Summer of 2015-2016, 99 teachers attended the Boot Camp, which was slightly less than last year's January participation of 124 teachers. Participation in this course results in a multi-year strategic plan including a detailed and actionable first year roadmap. SINET intends for the Boot Camp to be an immersive experience that empowers school and district leaders to develop a vision-directed, comprehensive plan for professional learning. Upon attending, leaders participate in strategic discussions and activities to determine how they will use the Edivate platform to support teacher growth and effectiveness. Boot Camp helps develop a comprehensive plan to get the most out of professional learning programs through intentional application of the School Improvement Network Strategic Planning Framework. In Table 30, we provide an overview by district and charter of the number of participants and number of days for attendance to the Bootcamp training.

District or Charter	# of Participants	Days
District		
Alpine	15	3
Cache	12	3
Carbon	5	3
South Summit	7	3
Tintic	5	3
Wayne County		
Weber	7	3
Washington		
Total	**51**	**18**
Charter		
Beehive Academy for Science and Technology	6	3
Monticello Academy	5	3

Noah Webster Academy	12	6
Providence Hall	12	6
Quest Academy	5	3
Utah Schools for the Deaf & Blind	8	3
Total	**48**	**24**
TOTAL	**99**	**42**

Table 30. Bootcamp Training Participants and Number of Days by District and Charter

EDIVATE ESSENTIALS

The purpose of the Edivate Essentials course is to provide the essentials for using Edivate for professional development. This year, 680 teachers participated in the Edivate Essentials Training Part 2. Many teachers did not need Edivate Essentials Training Part 1, having completed it during the 2014-2015 academic year. As the name suggests, participants in Edivate Essentials will learn to integrate the essential functions of Edivate into their professional learning routines. They will learn to find professional learning videos that apply directly to mission-critical needs, track professional learning activities and access reports to provide evidence of progress. They will also collaborate with other education professionals across the country and around the world. In Table 31, we provide an overview of the participants and number of days of attendance for the Edivate Essentials Part 2 training by district and charter.

District or Charter	# of Participants	Days
District		
Alpine	151	6.5
Beaver	70	4
Carbon	37	2
Iron	52	3
Nebo	22	1
North Sanpete	40	0.5
Piute	11	2
Rich	5	1
S. Sanpete	41	2

San Juan	11	1
South Summit	15	1
Tintic	4	1
Weber	26	1
Washington	33	2
Total	**518**	**28**
Charter		
Moab Community Charter	10	1
Monticello Academy	20	1
NUAMES Academy	3	1
Pinnacle Canyon Academy	32	1
Quest Academy	17	1
Summit Academy- Elementary	16	1
Summit Academy- HS	16	1
Syracuse Arts Academy	3	1
Utah Schools for the Deaf & Blind	45	3
Total	**162**	**11**
TOTAL	680	39

Table 31. Edivate Essentials Part 2 Participants and Number of Days by District and Charter

SCHOOL LEADERSHIP M4 FRAMEWORK

The M4 Leadership Framework is a construct that can be used to facilitate effective professional development in schools and districts through Edivate. In 2015- 2016, 1,302 teachers attended the M4 Leadership Framework, which was a dramatic increase compared to 2014-2015, where 268 teachers attended this PD opportunity. The framework focuses on 4 M's: Map, Model, Motivate, and Monitor. This construct can be used to create focus objective folders, add content to focus objective folders, share content with other users, use collaborative viewing, create groups, and generate reports. This framework provides school and district leaders with a road map and step-by-step direction for making Edivate a successful professional learning experience for everyone involved.

The School Improvement Network model for implementation of Edivate has a strong district or charter school leadership team attend a boot camp. There they learn about the product and spend time developing a three-year implementation plan, focusing on year 1 in more depth. Some districts start small by selecting a specific group of teachers to receive training on Edivate, such as new teachers.

Some districts committed to use this platform for a large part of their professional development. In preparation, they took more time up front to invest in the three-year development plan, compared to schools where Edivate is not the central focus. In the following table, we provide information about participants and days of training called "implementation meetings" that were held at some point from January to August 2015. In Table 32, we provide an overview of the implementation plans we received from Jake Hickey, the Implementation Specialist at School Improvement Network (SINET).

District or Charter	# of Participants	Days
District		
Alpine	116	16.5
Beaver	55	5
Cache	6	0.5
Canyons	2	1
Carbon	10	1.5
Davis	27	2.5
Iron	28	3.5
Logan	3	0.5
Murray	5	1.5
Nebo	7	1
North Sanpete	77	3
Park City	14	1.5
Piute	7	2
Provo	17	3.5
Rich	5	0.5
S. Sanpete	160	6.5
San Juan	20	3
Tintic	27	3
Wayne County	12	1.5

Weber	18	2
Washington	250	8.5
Total	**866**	**68.5**
Charter		
Beehive Academy for Science and Technology	3	1.5
Moab Community Charter	2	1
Monticello Academy	14	2
Noah Webster Academy	7	2.5
NUAMES Academy	4	0.5
Pinnacle Canyon Academy	32	2
Providence Hall	15	3.5
Quest Academy	12	2.5
Summit Academy- Bluffdale Elementary	51	5.5
Syracuse Arts Academy	6	1.5
Utah Schools for the Deaf & Blind	115	5.5
Multi-district implementation meetings	175	5
Total	**436**	**33**
TOTAL	1,302	101.5

Table 32. Implementation Meeting Participants and Days by District and Charter

Methods

In July 2015, we received the first participant list, which included the names and e-mail addresses of 18,047 teachers documenting licenses delivered. In August, 2015, we received the first usage file, and we then received a cumulative usage file from August until June. According to Edivate, their fidelity measure is 10 minutes of viewing per month. The usage average for 11 months was 14.25 minutes, averaging 1.3 minutes per month.

Pre/post survey instruments were administered to both teachers and administrators using Edivate in 2015-2016. Attitudinal, knowledge, and skills based data was collected with these surveys. Survey invitations were sent to LEA contacts who then distributed them to all participating teachers. Included was a Letter of Information and an option to opt-out of the survey.

Each survey was analyzed using Open Coding for qualitative analysis (Strauss & Corbin, 1998). Any quantitative data obtained through the survey instruments were summarized into frequency counts. Appropriate tables and graphs were constructed from this data for integration into this report. In addition to surveys, assessment data was to be analyzed.

The end goal for evaluation of this program was to analyze participating teachers' students' SAGE scores. Thus, a plan was developed to collect teachers' state IDs, or CACTUS IDs, which could then be sent to the Utah State Board of Education (USBE), who would then provide these teachers' students' SAGE scores.

To this end, teachers' CACTUS IDs were collected from school districts beginning in September 2015. These were merged with usage data using methods in Python, Java, and Google's Open Refine. These would have been sent to USBE to be merged with SAGE data; however, the sample of teachers who used Edivate with fidelity was too small to be representative of any student demographic. Therefore, students' SAGE score analysis was postponed until a larger sample of teachers who used Edivate with fidelity could be obtained.

Results

Teacher Perceptions Towards Edivate Product

Among the 234 teachers who described their overall satisfaction with the Edivate product (as shown in Table 33 and Figure 39), the responses indicated 40% held positive perceptions towards Edivate, 33% held negative perceptions, 5% were indecisive, and 3% found the product was not applicable.

Response Category	% of Responses	Sample Response

Positive	40%	*"Edivate professional development videos provide me the opportunity to view other teachers teaching their students. I can watch these videos when it is convenient to me. I also feel it helps me reflect on my practices by viewing others."*
Negative	33%	*"Boring, too long, get distracted. Who has extra time?????"*
Mixed	19%	*"My motivation for watching them is the master teachers that are on there and the lessons I can learn from them. My motivation for not watching them is that it takes more time to seek out what I am looking for."*
Indecisive	5%	*"My work computer does not have a sound card, and I never remember to watch at home, which is why I haven't used them much. I don't know if the product is useful."*
N/A	3%	

Table 33. Teacher Satisfaction with Edivate Product (N=234)

Positive responses from teachers had the highest frequency, but there were also a significant number of negative responses. The negative responses, however, tended to focus on barriers outside the scope of the STEM AC implementation of Edivate. For example, a number of teachers noted that they did not have extra time, or their equipment was insufficient (e.g., no speakers) for use of the PD products. These barriers might be overcome through an increased focus from administrators on Edivate as PD. For example, some administrators organized and/or lead sessions that included Edivate as the main source of PD for the group.

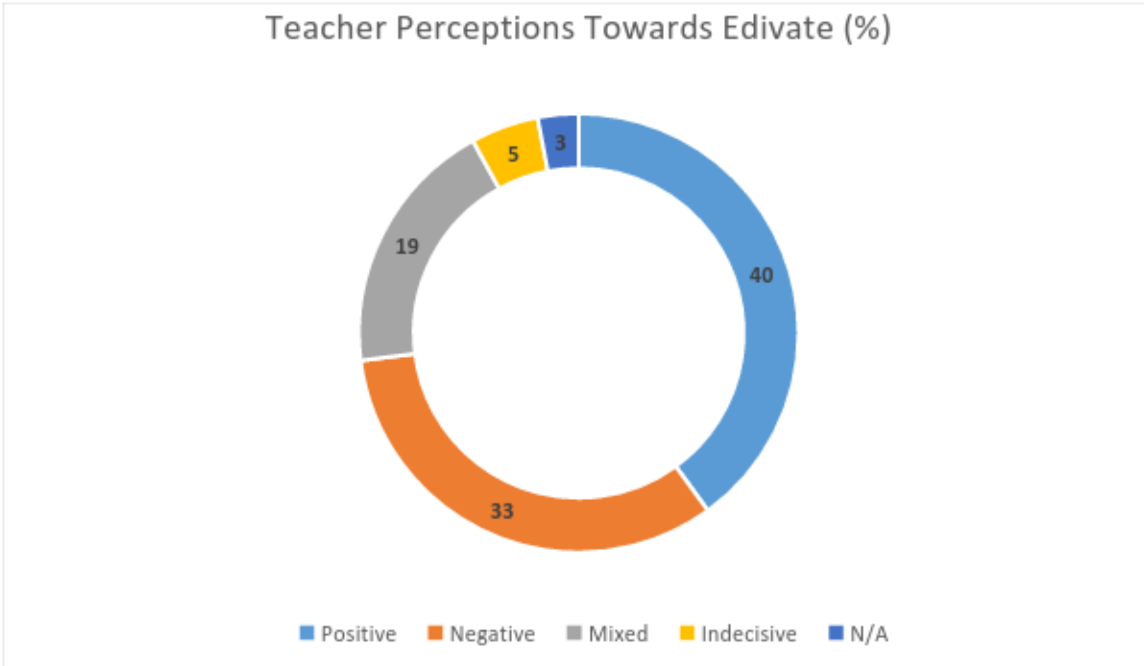


Figure 39. Summary of Teacher Perceptions Towards Edivate (N =234)

Teacher Satisfaction

Among the 281 teachers, 94 of the respondents described the following features with which they were satisfied (as shown in Table 34 and Figure 40): helpful teaching ideas and strategies suggested from the videos (66%), reflection and analysis of teaching methods and practice (23%), ease of use and availability (21%), and general satisfaction (6%).

Response Category	% of Responses	Sample Response
General satisfaction	6%	*"I think they ARE useful (especially the extended classroom ones) because it gives me a chance to observe another teacher- and one who is coming from a different perspective and set of experiences than I have had (an opportunity that is hard to come by in this profession since all teachers work the same hours)."*
Reflection and analysis of teaching methods and practices	23%	*"Edivate professional development videos provide me the opportunity to view other teachers teaching their students. I can watch these videos when it is convenient to me. I also feel it helps me reflect on my practices by viewing others."*

Helpful teaching ideas and strategies	66%	*"They are useful because they allow me to see what specific teaching practices look like in a classroom instead of being theoretical only."*
Availability and easy to use	7%	*"I believe they are extremely effective if you use them. You can watch them over and over again and stop and take notes.*

Table 34. Satisfaction with Edivate Product (N=94)

Teachers were most satisfied with the availability of videos showing other teachers implementing specific teaching practices. Many of the comments reference classroom management practices in particular. While helpful for generating ideas for teachers to implement within their own classrooms, more value could be gained if teachers then viewed and shared videos of themselves implementing these ideas. Teachers may then reflect on their implementation and the suggestions gained through feedback from other teachers. Repeating this cycle results in a refinement of the teaching practice of interest. Based upon the data received by the evaluation team, it is unclear that this refining process is occurring.

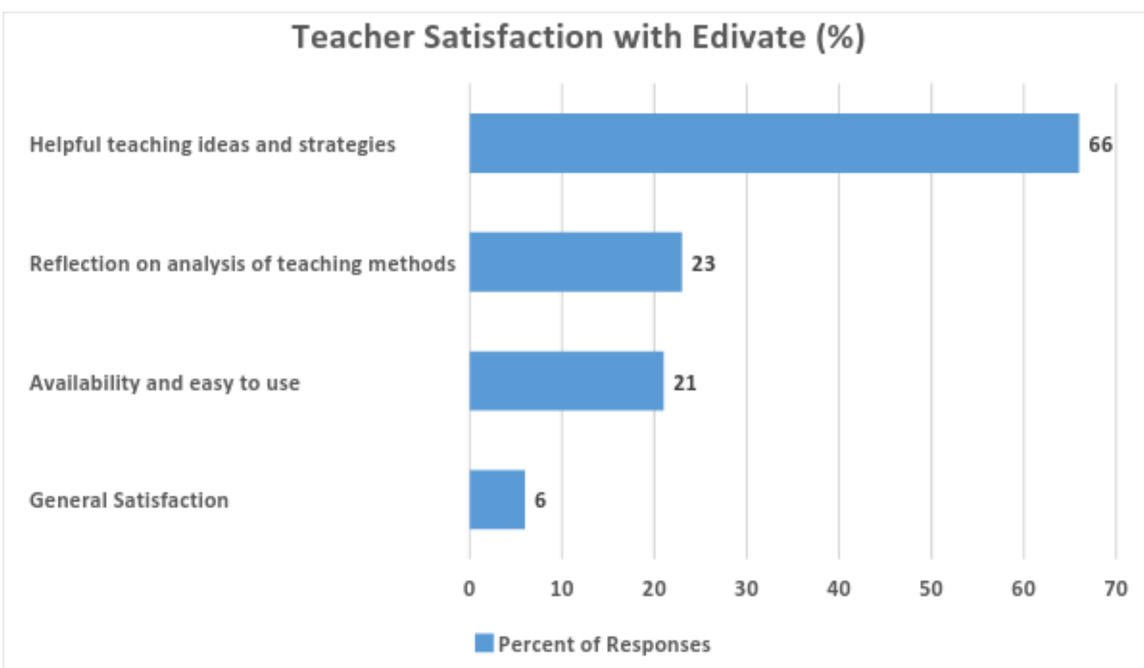


Figure 40. Summary of Teacher Satisfaction with Edivate

Teacher Concerns

As shown in Table 35 and Figure 41, 78 of the respondents shared the following concerns: Lack of content-specific videos (37%), time consuming (22%), have not used the product (26%), and no collaboration opportunities (13%).

Response Category	% of Responses	Sample Response
No collaboration opportunities	13%	*"I like being able to communicate in-person with others."*
Time consuming	22%	*"Teachers have a great deal to do in the way of grading, testing, planning, meeting, emailing, and filling out forms. There is a limited time to watch additional training videos."*
Lack of content-specific videos	37%	*"I haven't found any videos that are my content specific, or class specific."*
Have not used the product	26%	*"I have not watched any of them."*

Table 35. Teacher Concerns with Edivate Product (N=78)

The largest response category was "Lack of content-specific videos." This is an interesting theme among the responses, given that the purpose of the PD platform was for teachers to upload videos of themselves teaching. It appears that this theme may stem from teachers perceived shortage of time for making their own videos. Thus, an increased focus on using this PD platform by administrators may improve the content-specific video selection outlined in teachers' responses. This increased attention from administrators and the increase in video selection could have a powerful combined effect toward increasing usage of the Edivate platform, while also providing the desired selection of video content.

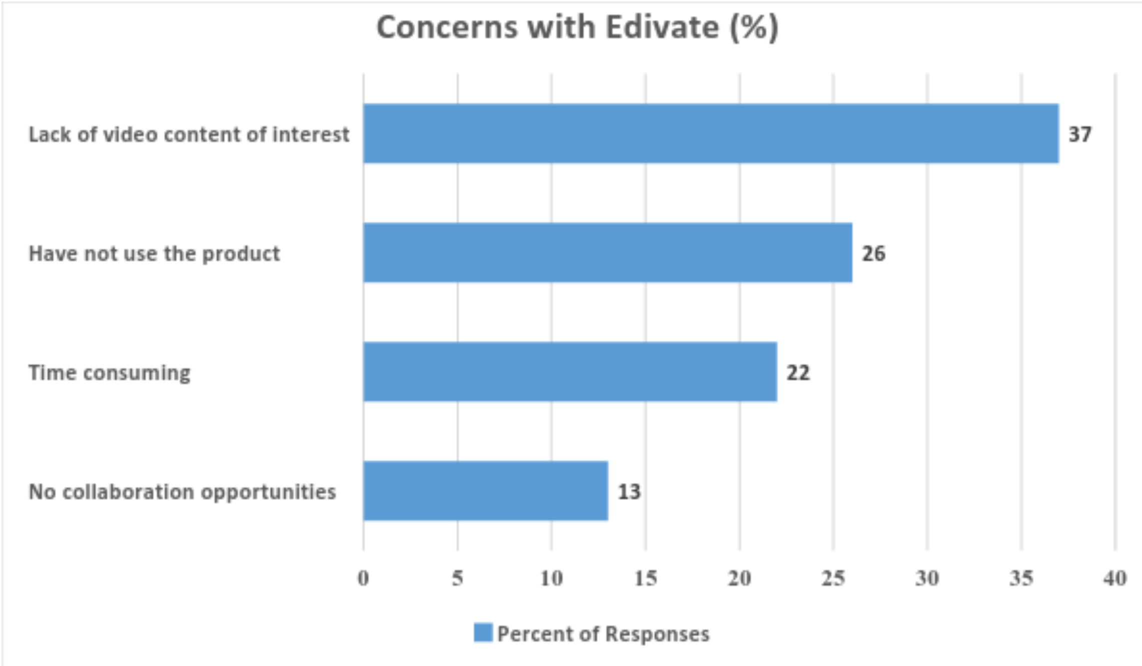


Figure 41. Summary of Teacher Concerns with Features of Edivate (N = 78)

Administration Perceptions Towards Edivate Product

Among the 30 administrators who described their perceptions and overall satisfaction with the Edivate product (as shown in Table 36 and Figure 42), the responses indicated 43% held positive perceptions towards Edivate, 13% held negative perceptions, 17% were indecisive, and 10% found the product not applicable.

Response Category	% of Responses	Sample Response
Positive	43%	*"Yes. I think the biggest thing is that they are seeing actual classroom examples in the videos. I have heard a lot more discussion with my teachers about STEM in general. They are also seeing a wide variety of ways to incorporate STEM into their teaching and that not all of the lessons have to have fancy materials or technology. It is making STEM more visible and doable for teachers."*
Negative	13%	*"No, but we don't use it a lot. Plus, I am sorry to say, I don't think this really is a STEM program.*

Mixed	17%	*"In some classrooms. Other teachers are just recognizing the power of Edivate."*
Indecisive	17%	*"Not sure. I am not sure how many teachers are using it."*
N/A	10%	

*Table 36.*Administrator Satisfaction with Edivate Product (N=30)

Similar to teachers, most administrators also found the content of the videos valuable. They felt that these videos improved teachers' attitudes and awareness toward STEM subjects (see Figure 42). There were few negative responses regarding administrators' satisfaction with the Edivate platform. Many of these negative responses seem to have the same theme as those seen in the teachers' responses. One administrator noted that "… I am sorry to say, I don't think this really is a STEM program." Though this administrator did not specify the reasons for considering Edivate as other than a STEM program, increasing the STEM related teaching videos may assuage their concerns. Again implying that, if administrators increase support for STEM teachers in uploading videos of their teaching, then they will see an increase in the amount of STEM content contained in the Edivate platform.

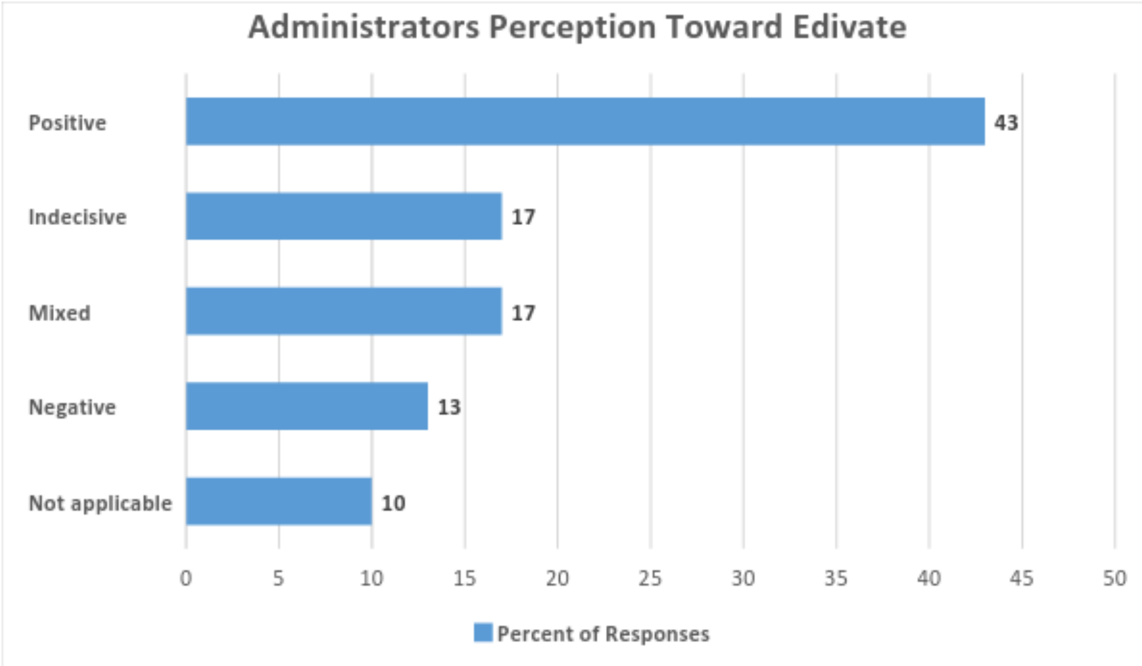


Figure 42. Summary of Administrators' Perception Towards Edivate

Administrators' Perceptions Towards How Teachers Should use Edivate

Administrators who described their perceptions regarding the best method for teachers' use of the Edivate product (as shown in Table 37 and Figure 43) included collaboration and professional learning communities (34%), individualized use (38%), requiring use (9%), and no suggestion (19%).

Response Category	% of Responses	Sample Response
Collaboration/ PLC	34%	*"Within their PLC's to talk about, share and process helpful videos."*
Individualized	38%	*"Right now it has been a pick and choose what you want to learn about."*
Required	9%	*"We encourage them to watch a minimum number per month."*
No suggestion	19%	

Table 37. Administrators' Perception Toward How Teachers Should use Edivate (N=30)

The largest response category for how administrators think teachers should use Edivate, was “Individualize,” which implies that administrators have given teachers the opportunity to “… pick and choose what [they] want to learn.” This attitude is consistent with survey responses that outline a less than optimal selection of STEM related videos. While this freedom allows teachers to explore Edivate content and find videos that they think will be most helpful in their classroom, it does not encourage teachers to share videos of their own teaching. A possible solution to this outcome, would be to have administrators take a more active role in how teachers use the Edivate platform. The second highest response rate showed that administrators believe that collaboration in teachers’ professional learning communities (PLCs) provides the best use of the Edivate platform. This type of implementation would be a great place to share and critique teacher-made videos.

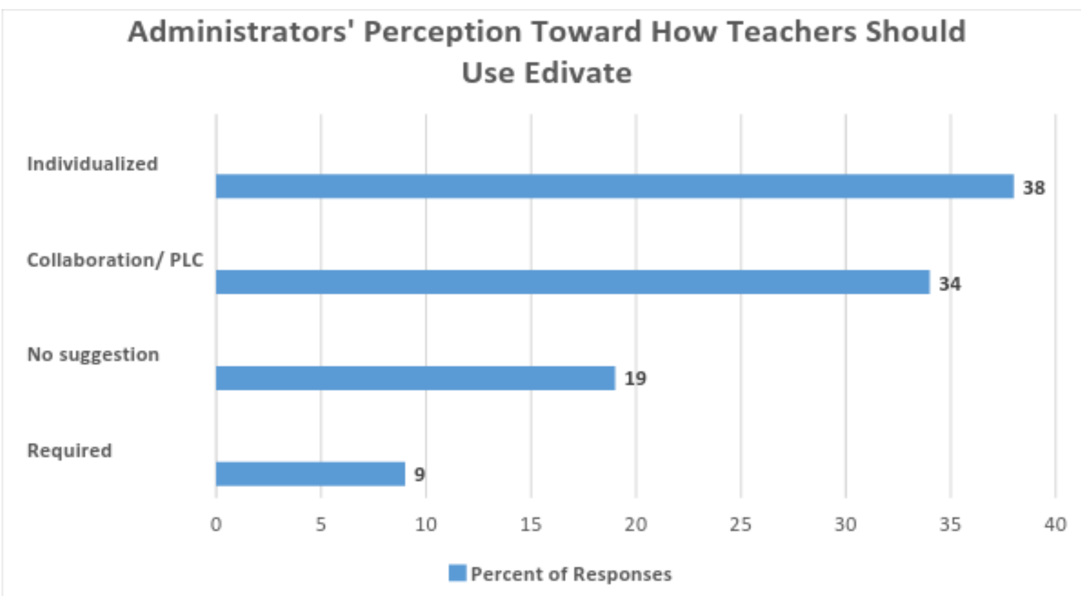


Figure 43. Summary of Administrators’ Perception Toward How Teachers Should Use

Content Teachers Most Frequently Accessed

For the question concerning what content teachers most frequently accessed on Edivate, 154 teachers responded. As shown in Figure 44, responses indicate the most common content accessed was mathematics (28%), classroom management (28%), science (18%), technology (14%), not applicable (14%), engineering (12%), humanities (10%), and general teaching ideas and strategies (6%).

Supporting teachers' and administrators' perceptions that there was an insufficient amount of STEM content available on the Edivate platform, around half the content that teachers accessed was not directly STEM related. However, the largest content accessed by frequency was mathematics. This statistic could direct administrator's efforts toward leading teachers to make videos for the STEM fields that have been accessed least.

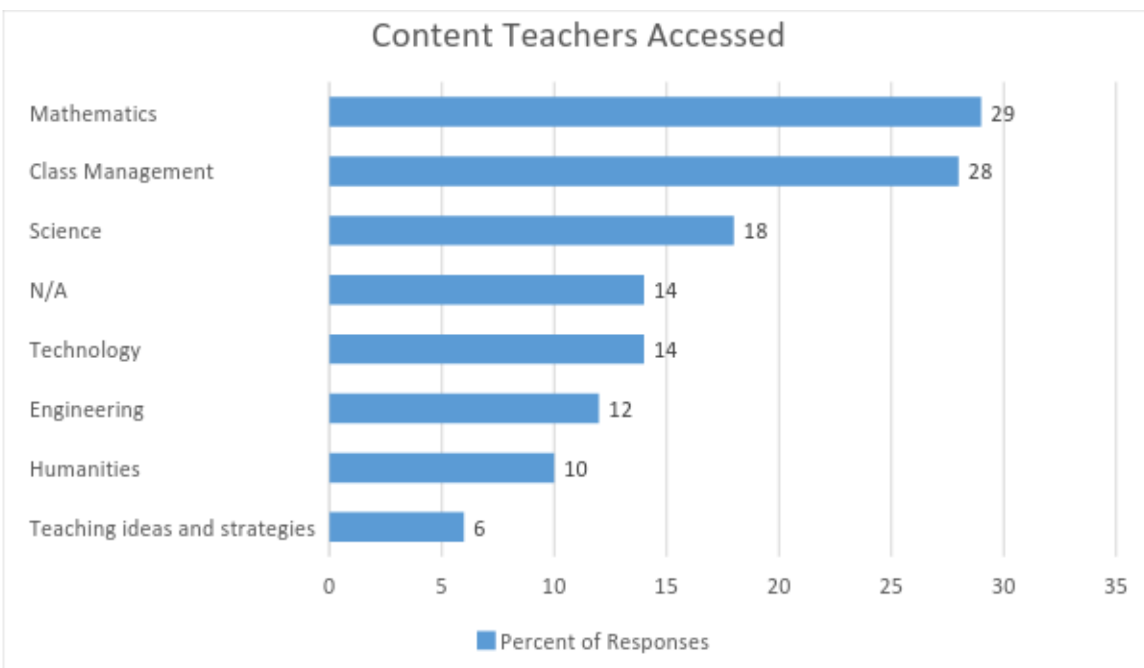


Figure 44. Summary of Content Most Frequently Accessed (N = 154)

Teacher Motivation for Using Edivate

Among 258 teachers who filled out the survey, only 129 teachers described the following features which motivated them to use the Edivate product (as shown in Table 38 and Figure 45): improving teaching ideas and strategies (47%), required by administrators (33%), reward (15%), and general satisfaction (6%).

Response Category	% of Responses	Sample Response
General satisfaction	6%	*"I have never been disappointed in any of the videos I've watched. I am always inspired and excited about being in education after I watch a video."*
Improving teaching ideas and strategies	47%	*"The expected outcome was to improve the teaching skills of our staff. The videos did help and provided a third party to talk about concerns so it was not always one teacher telling another teacher that he or she was doing something wrong. It helps maintain a close staff but still address concerns effectively."*
Required by administrators	33%	*"I am motivated to watch because my principal asks us to watch and tells us how much we will we gain. I have to say the chance to win a prize does motivate me sometimes as well. I like the convenience of watching at my convenience and not having to miss school to take advantage of professional development!"*
Reward	15%	*"I loved the contest for iPad, didn't win though. I did look for what qualifies for stem lessons."*

Table 38. Motivation for Watching Edivate (N=129)

The largest response category, "Improving teaching ideas and strategies," outlines teachers' support for the Edivate platform, while the second largest response category, "Required by administrators," outlines administrators support for this form of PD. Acquiring 80% of all responses, these two categories imply that many teachers and administrators feel that Edivate could be an effective tool for providing PD that is both flexible and focused by content area. An increase in the amount of STEM content made available to these teachers and administrators may help increase the Edivate usage level. Further, a focus on empowering STEM teachers to record and upload videos of their teaching will fill the need for more STEM content on the Edivate platform.

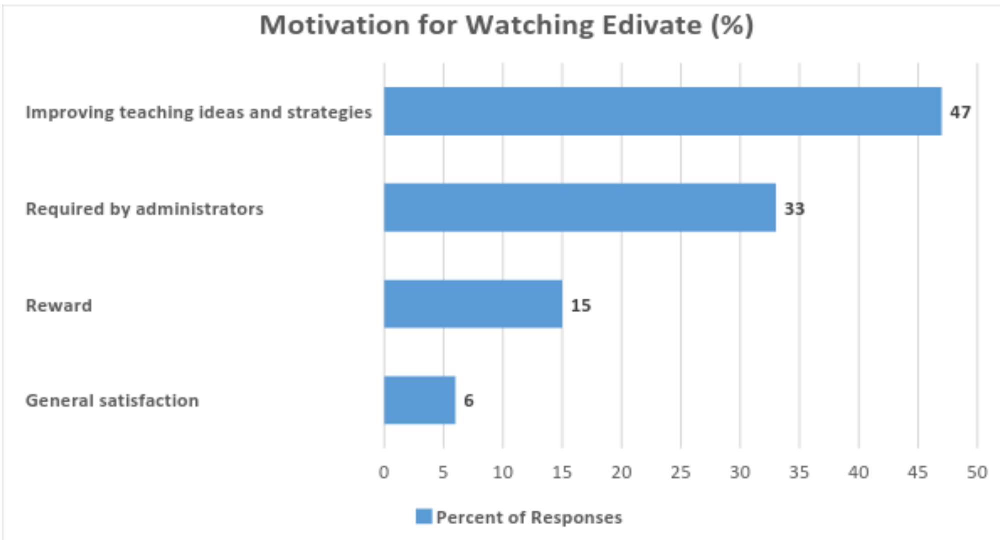


Figure 45. Summary of Teacher Motivation for Watching

Teacher Motivation for Not Watching Edivate

As shown in Table 39 and Figure 46, only 118 of the respondents shared the following concerns which produced an unmotivating effect with respect to Edivate usage: time consuming (57%), none (18%), have not use the product (11%), not relevant (9%), dislike of virtual training (5%).

Response Category	% of Responses	Sample Response
Time Consuming	57%	*"Time is the biggest deterrent. As a full-time teacher, I spend large amounts of time being "engaged" with my students in daily lessons. These inquiries based lessons take significantly more time to plan and more effort to implement than directly instructing from a textbook. It is exciting to have time to watch videos and see various practices taught or modeled, but*

		watching a video takes TIME outside of fulfilling all that a teacher does in a regular work day (plus grading outside of school). Perhaps, as a new teacher, TIME is a bigger challenge than it may be for a more experienced season teacher.”
Not relevant	9%	*“I am not motivated because I either don't know about them, they are not at a convenient time, or they are not related to what I teach.’’*
Have not use the product	11%	*“I really can't respond to the questions on this survey in any way that will give you good data since I am not at all aware of the Edivate professional development videos!!!!!”*
Dislike of virtual training	5%	*“I (personally) prefer live instruction, I do not care for canned/webinar/video/etc... instruction.’’*
None	18%	*"I feel we were expected to watch many videos each month and implement everything into our teaching. I do not feel like this outcome was achieved, as we have many things to do and watching videos is the last "to-do" on our list.”*

Table 39. Motivation for Not Watching Edivate (N=118)

Teachers’ biggest reason for not wanting to use Edivate, was a lack of time. Once again, these data support a greater focus on supporting teachers’ usage of the Edivate platform. Specific time should already be set aside for teachers PD regardless of the method of delivery, thus, if a district specifies that this time should be used for Edivate, then usage of the platform will increase. This, however, may not in and of itself increase the amount of STEM content available. It may help to create PD plans that specifically encourage teachers to create their own videos.

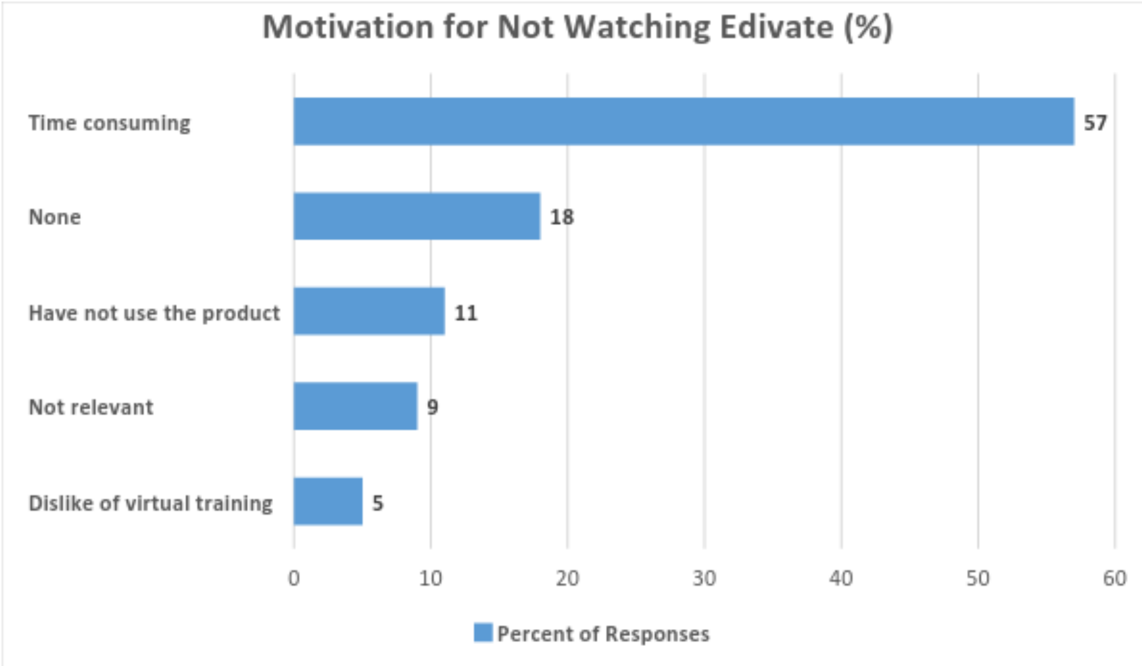


Figure 46. Summary of Teacher Motivation for Not Watching

Teacher Outcomes for Watching Edivate

For the question concerning teacher's outcome with PD from SINET, 207 respondents included valid responses. As shown in Table 40 and Figure 47, responses for outcomes included: to improve teachers' instructional practices (47%), to gather more teaching ideas (38%), not available (10%), and to collaborate with one another (3%).

Response Category	% of Responses	Sample Response
Teaching ideas	38%	*"I hope to be able to reach all different types of learning differences. I have found some great ideas through watching the videos."*
Collaboration	3%	*"Expected that we will collaborate and gain ideas. And yes this outcome was achieved."*
Improve instructional practices	47%	*"The expected outcome is to use better teaching skills and inspire students to think, reason, and ponder. "*
N/A	10%	

Table 40. Teacher Outcomes for Watching Edivate (N = 207)

The two largest categories for teacher outcomes from watching Edivate are "Improve instructional practices" and "Teaching ideas." A major goal of PD is to improve instructional practices. Given that this category had the highest frequency of responses, teachers feel that Edivate meets this need. The second largest category, "Teaching ideas," is not necessarily a goal of PD. Despite the fact that many teachers feel that the Edivate platform meets their PD needs, it will only meet the goal of LEAs if the teaching practices presented are research based. Thus, a method for determining whether or not a particular video is sharing research based teaching practices may need to be incorporated in this PD platform.

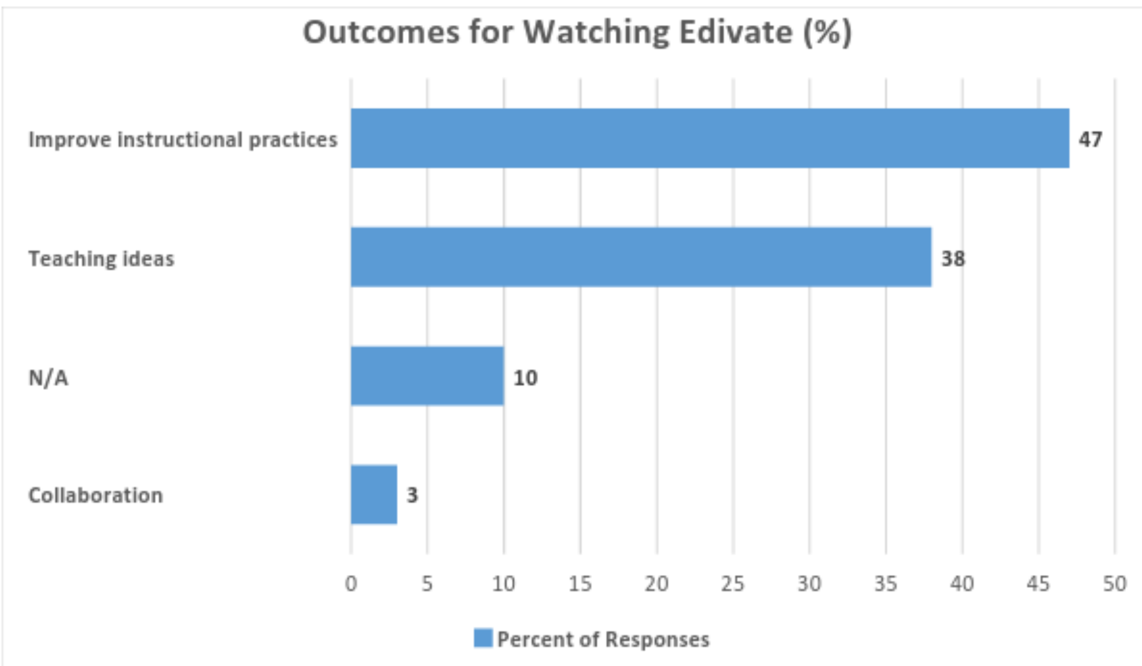


Figure 47. Summary of Teacher Outcome for Not Watching

From these 207 responses, 31 percent of teachers responded that they have achieved the desired outcomes, 18 percent of teachers somewhat have achieved their desired outcomes, and 9 percent of teachers said that they have not been able to achieved their desired outcomes (see Table 41 and Figure 48).

Response Category	% of Responses
Yes	31%
No	9%
Somewhat	18%
Not Sure	2%

Table 41. *Have Teachers Achieved the Mentioned Outcomes (N = 207)*

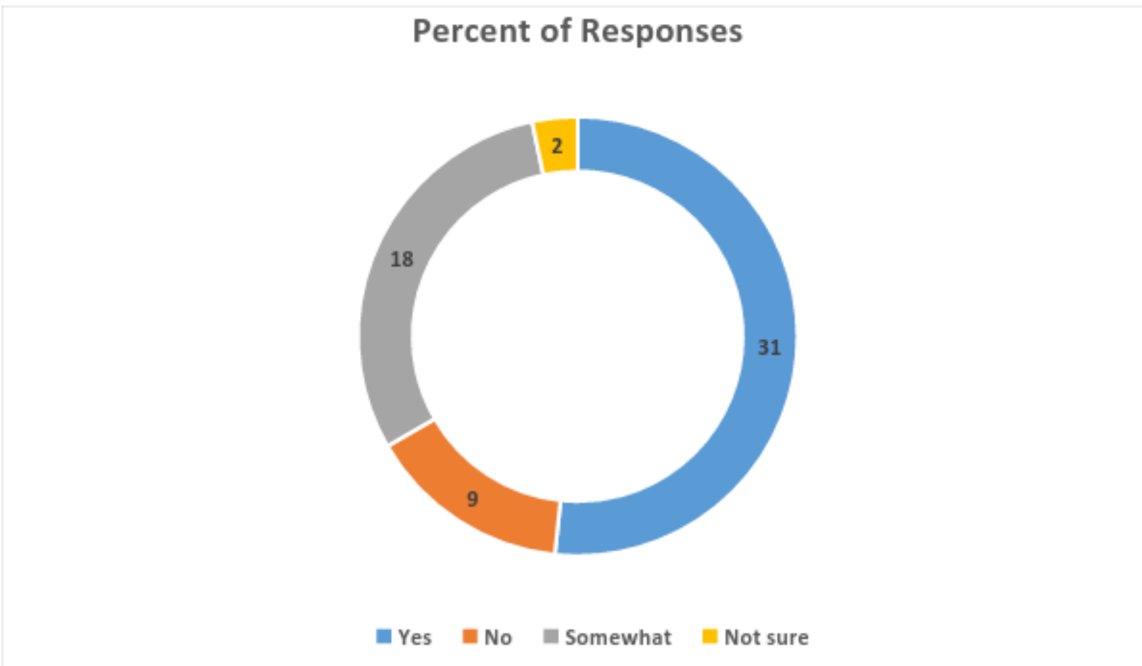


Figure 48. *Summary of Teacher Who Have Achieved the Mentioned Outcomes (N = 207)*

School Improvement Network (SINET) Supported LEAs and Partially Supported LEAs

There were ten school districts and charters that received the most support from SINET for Edivate implementation. According to SINET records, those schools included the following: Washington District, Weber District, Park City District, South Sanpete District, North Sanpete District, Alpine District, Provo District, Summit Academy, School for Deaf and Blind, and Monticello Academy. Districts who were fully supported by SINET requested extensive professional development for their districts, whereas, partially supported districts did not actively pursue PD from SINET. Table 42 lists the usage, both total and average, on an individual level for those district who received the most support, and in aggregate for district and charters who received less support. Of more interest, is the data in Table 42 which is summarized in Figure 49. This data shows that while there was a group of districts who received more support, this support did not have an effect on usage, as the average usage between the two groups is nearly equal.

District/ Charter	Total Usage over 11 Months (Minutes)	Average Usage per Teacher over 11 Months (Minutes)
Washington District (N = 1,952)	22,087	11.33
Weber District (N =1,786)	10,295	5.76
Park City District (N = 339)	2,124	6.27
South Sanpete District (N = 229)	11,499	50.21
North Sanpete District (N = 426)	47,080	110.52
Alpine District (N = 1,260)	38,693	30.71
Provo District (N = 801)	18,425	23
Summit Academy (N = 168)	6,917	41.17
School for Deaf and Blind (N = 240)	4,922	20.51
Monticello Academy (N = 43)	1,390	32.33
Other District (N = 1,020)	57,426	5.6
Other Charter (N =551)	36,231	65.75

Table 42. *Teacher Usage for Edivate Supported VS. Partially Supported LEAs (N=41)*

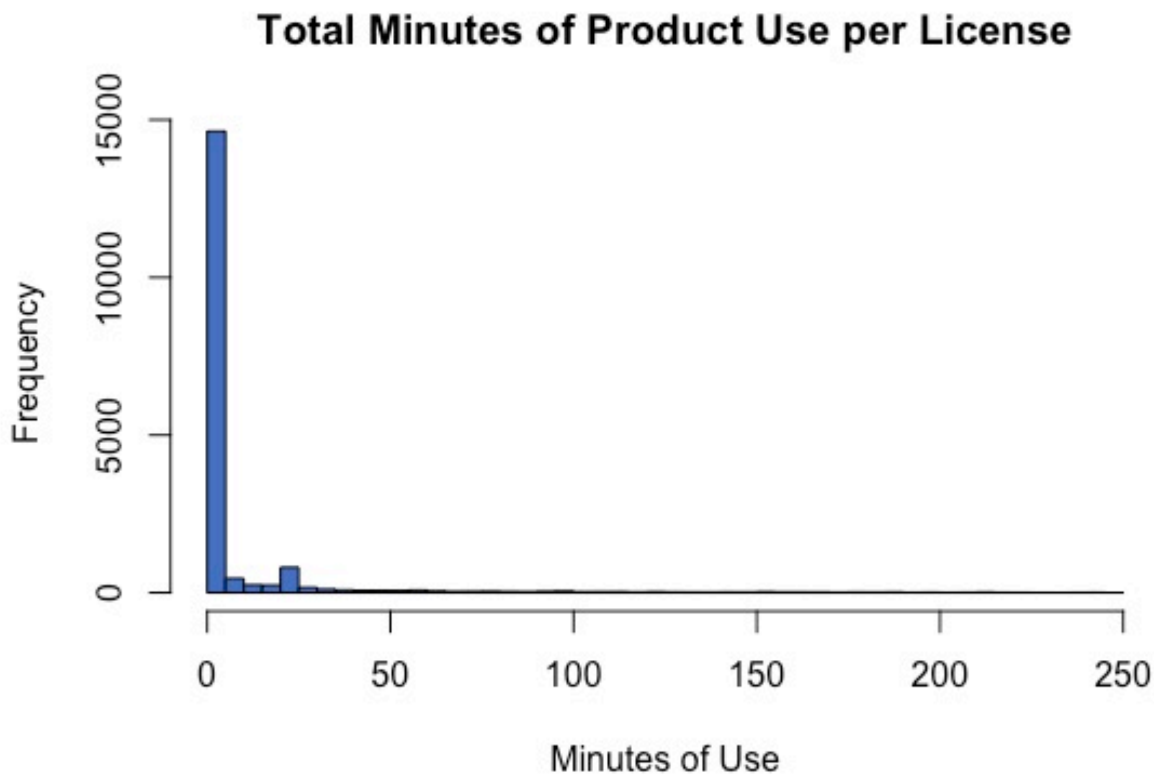


Figure 49. *Total minutes of product use per license*
Note: 15 Licenses whose usage exceeded 250 minutes were excluded

We note that a direct correlation between preparation to use Edivate and its usage should not be drawn, since LEAs may use Edivate at their own discretion. This discretion allows LEAs to incorporate Edivate within their existing professional development program (see Table 43 and Figure 50). Thus, we expect usage to vary by LEA. With this in mind, the data do suggest that experimenting with the teacher preparation employed by SINET may lead to a method that increases product usage.

	Total Usage over 11 Months (Minutes)	Total Usage over 11 Months (Hours)	Average Usage per Teacher over 11 Months (Minutes)
Supported LEA Districts (N = 10)	163,432	2723.87	13.96
Less-Supported LEA Districts(N = 31)	93,657	1560.95	14.4

Table 43. Usage in LEA and Less-Supported LEA Districts

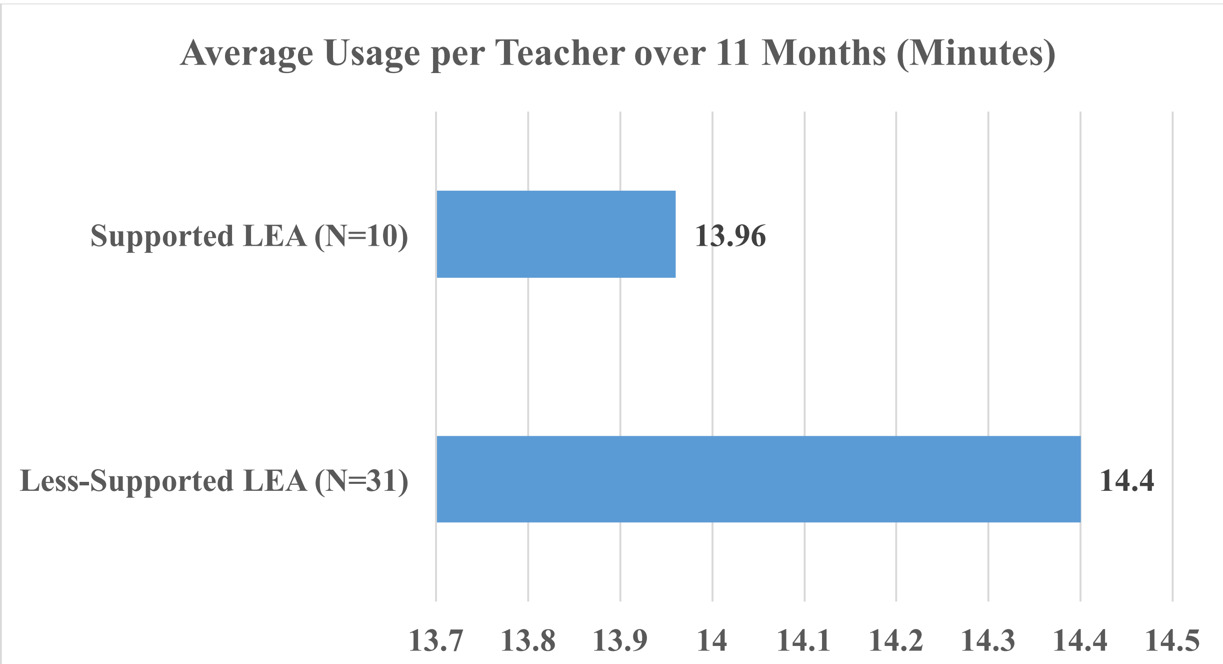


Figure 50. Summary of Minutes Watched Over 11 Months (N = 18,045)

Summary

Results show that a majority of teachers who took the survey were satisfied with the platform, due to teaching ideas and strategies they gained, the ability and ease of use, and the ability to reflect and analyze teaching methods and practices. In addition, many teachers and administrators were satisfied with Edivate, as it provides teachers the freedom and flexibility to assess content at their convenience. Moreover, they noted that Edivate was an effective form of collaborative PD, providing opportunities to reflect upon teaching practices, discuss teaching methods, and share ideas for future lessons. However, a large minority of teachers expressed concerns with the digital platform and content selection, lack of time to watch the videos, and the lack of collaboration.

Recommendations

To evaluate the effectiveness of Edivate as a form of professional development it is important to encourage usage and to ensure that there is data available to measure changes in instruction. Thus, it is recommended that an expectation be set for each participating district/charter to have a certain amount of teachers upload a pre/post video of instruction. These videos may then be used to use to assess changes in instruction. To encourage participation, one option could be to make use of the product the following year contingent upon video uploads. Another option would be to give an incentive to either a school leader or district leader who has the role of implementation support. This could be a stipend that they would receive once the videos were uploaded (pre and post). According to SINET, maximum results are achieved when teachers access videos at least ten minutes a week. Administrators could encourage this level of engagement by, not only providing teachers the flexibility to watch videos they choose, but also by selecting and providing teachers with the opportunity to analyze and reflect on targeted videos during PLCs and faculty meetings to increase access and teacher usage of this product. Recertification credit or university credit might further encourage teacher participation.

Following these recommendations may increase the selection and quantity of STEM related videos, while simultaneously increasing collaboration and feedback regarding teaching practices among teachers and administrators. Finally, these outcomes may have a positive impact on student outcomes, which can be measured by increased usage of the Edivate platform.

References

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brrain, Mind, Experience and School.* Washington D. C.: National Academy Press.

Fishman, B., Konstantopoulos, S., Kubitskey, B. W., Vath, R., Park, G., Johnson, H., & Edelson, D. C. (2013). Comparing the impact of online and face-to-face professional development in the context of curriculum implementation. *Journal of Teacher Education, 64*(5), 426-438.

Glassett, K. F., Shaha, S. H., & Copas, A. (2015). The impact of teacher observations with coordinated professional development on student performance: A 27 state program evaluation. *Research Highlights in Technolgoy and Teacher Education*, 183-188. (L. Liu, & D. C. Gibson, Eds.) Society for Information Technology & Teacher Education.

King, K. P. (2002). Identifying success in online teacher education and professional development. *The Internet and Higher Education, 5*(3), 231-246.

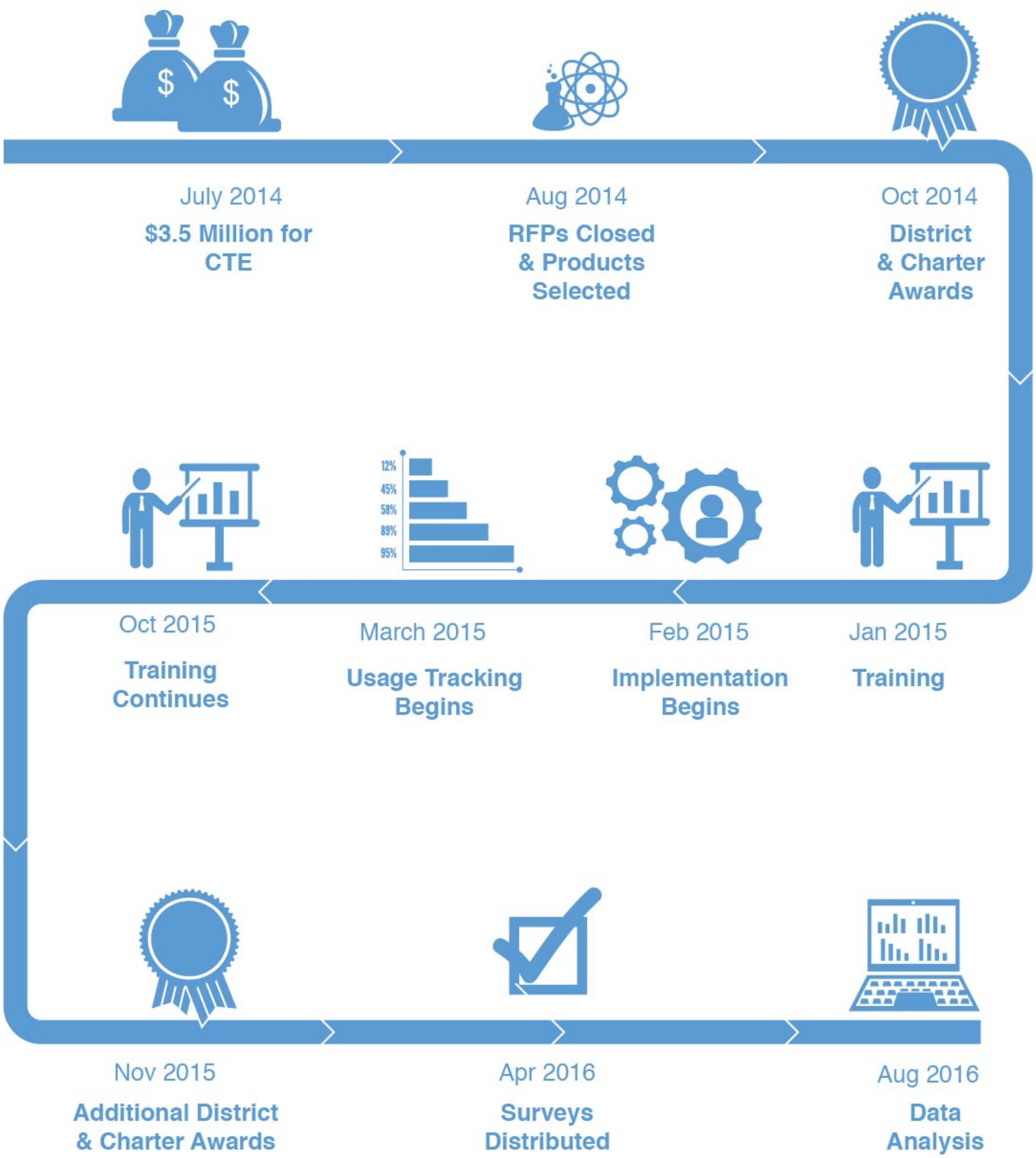
Lock, J. V. (2006). A new image: Online communitites to facilitate teacher professional development. *Journal of Technology and Teacher Education, 14*(4), 663.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Procedures and techniques for developing grounded theory.* Thousand Oaks, CA: Sage.

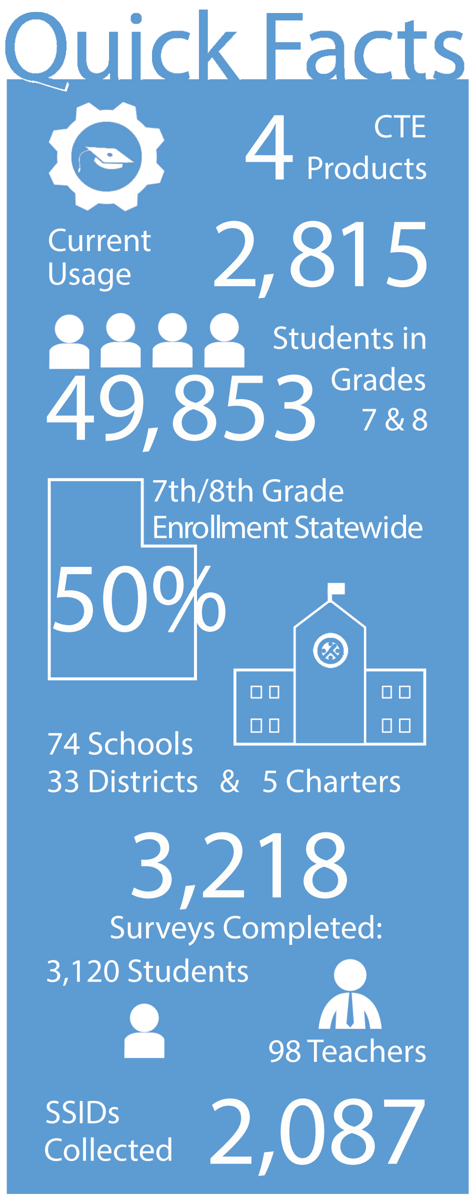
Wei, R. C., Darling-Hammond, L., Andree, A., Richardson, N., & Orphanos, S. (2009). *Professional learning in the learning profession: A status report on Teacher Development in the United States and Abroad.* Dallas, TX: National Staff Development Council.

Chapter 4 - CTE Applied Science

CTE Applied Science Grants Implementation



Introduction



Careers of the 21st century call for a workforce that is skilled in a variety of far more technical disciplines than have been seen in the past. For example, a typical "data cruncher" may no longer rely on Microsoft Office skills, but may instead expect to work with data manipulation and visualization tools that will require some knowledge of computer programming, and the creativity to innovate. Students will need a 21st century curriculum to prepare them for the 21st century workforce. This modern curriculum will integrate multiple disciplines and bring students together to collaborate and solve complex problems (The Partnership for 21st Century Learning, 2016; National Education Association, 2016).

Since its inception, career and technical education (CTE) programs have been viewed as ideal candidates for curriculum integration (Asunda, Finnell, & Berry, 2015). Curriculum integration weaves together multiple disciplines with emphasis on the underlying structure that unifies them. Contemporary CTE curriculum now includes a wider range of topics. For example, the Utah CTE core curriculum includes: agriculture, counseling and guidance, information technology, technology and engineering education, business and marketing, family and consumer sciences, college and career awareness, skilled and technical sciences, and more (UEN, 2016). Recognizing and blending unifying strands within such a diverse set of topics is a complex task that requires, at minimum, some detailed knowledge of each topic.

Research has shown that, if teachers are to successfully deliver an updated 21st century curriculum, an expanded scope in teachers' content and pedagogical knowledge will be necessary (Asunda, Finnell, & Berry, 2015). In-service teachers generally increase their content and pedagogical knowledge through professional development (PD). Research suggests that high quality PD should be extended over long periods of time, be frequent, in depth, content focused, allow for reflection, and enable inter-disciplinary collaboration (Asunda, Finnell, & Berry, 2015; Kleickmann, et al., 2013; Mukembo & Edwards, 2015). Thus, we would expect to see a successful implementation of contemporary CTE curriculum accompanied by PD with these qualities.

The success of a particular curriculum's implementation is usually measured by student achievement. Research has shown, that an assessments reliability and relevance is crucial to its accuracy in measuring student achievement (Cangelosi J. S., 2000; AERA, 2014). An assessment is reliable if it is self-consistent and consistently scored. Thus, any assessment designed to measure students' achievement in contemporary CTE courses should be scrutinized for its reliability and relevance.

In this evaluation, we consider the effectiveness of 4 CTE curricula implemented throughout Utah. Given the critical role of teachers' preparedness toward the implementation of a new curriculum, and, thus, student achievement, we will analyze teachers' perceptions of the PD provided by the 4 vendors: ITEEA, Pitsco, Project Lead the Way, and STEM Academy.

The end-goal of this evaluation was to analyze student outcomes via SAGE scores. This report contains a detailed discussion of concerns related to using available assessments to measure student achievement in the evaluated CTE courses. These concerns include data quality and the suitability of using vendor assessments and SAGE scores to measure students' CTE achievement.

Finally, this report outlines other issues that occurred during the CTE curricula's implementation. Before attending to these matters, we give a description of the implementation process followed by a description of each product.

Product Implementation

We provide a timeline of the implementation of the Career Technical Education (CTE) Applied Science Grants over the past academic year 2015-16 at the beginning of this section. The project started after HB 150 was finalized in July 2014 and was revised with HB 45. The legislation included funding for products and professional development both designed to bring more "real world" applications and "hands on" experiences to grades 7 and 8 CTE courses. These courses include a wide array of projects throughout many disciplines. The STEM Action Center released the RFP and selected the products in August 2014 to be used through Spring 2016. The four products that were awarded were Engineering by design (EbD) produced by ITEEA (International Technology and Engineering Education Association), Pitsco, Project Lead the Way, and the STEM Academy. Unlike the other grants where Local Education Agencies (LEAs) receive licenses for product use, the CTE grant participants requested implementation resources, such as 3D printers, VEX Robotics, etc. Each LEA had a slightly different plan for implementation. They outlined their needs in their application and the STEM Action Center notified each district or charter school of their award in October 2014.

In December 2014 the STEM Action Center finalized contracts with these four product vendors. Teachers attended professional development (PD) in January. After the PD, some teachers were ready to begin implementing in Spring 2015, but others felt the deployment of these grants was too late, so they requested to have implementation begin the following academic year, 2015-2016. Despite the delay for some LEAs, there were still some issues at implementation time. For example, due to technical problems, those who received STEM Academy licenses were unable to access their online content until December, and some not at all.

The vendors agreed to allow the LEAs to have the licenses for a year and a half. This allowed them to have access through the spring 2016 semester, to meet the needs of the schools awarded. The early implementers were able to begin in February 2015 and we started collecting usage data in March 2015.

The remainder of this section details the CTE products: ITEEA, Pitsco, Project Lead the Way, and STEM Academy, and their implementation for the 2015 Spring and Fall semesters. Given that these details remain unchanged from last year's report (Brasiel & Martin, 2015, pp. 19-40), they appear here in much the same form.

Product Descriptions

ITEEA

International Technology and Engineering Educators Association (ITEEA) proposed a program that follows a constructivist (or experiential) approach. This approach supplies students with applications of content contained in the state science and math standards. The name of the ITEEA program is Engineering by Design (EbD). They claim that this will develop "untapped, unrealized potential that, when properly motivated, will lead to the next generation of technologists, innovators, designers, and engineers (ITEEA, 2016)." EbD consist of two components: EbD Middle School Network School program and professional development (PD). EbD is designed for 7th and 8th grade middle school students and can be completed in two 18-week courses.

The grant from the STEM Action Center for each participating school included the option of a three hour, asynchronous, online workshop to get them familiarized with the EbD curriculum facilitated by an EbD Teacher Effectiveness Coach (TEC). In addition, the STEM Action Center also granted schools two additional PD options. First, they had the opportunity to attend a regional EbD five-day face-to-face authentic technology and engineering training that provided teachers with opportunities to engage in the course content under the guidance and supervision of a TEC. The second option was the opportunity to participate in a five-day Utah specific PD workshop. The workshop featured model lessons, program implementation, Utah specific standards articulation, and an outline of various avenues for successfully integrating STEM and CTE programs (Brasiel & Martin, 2015). Each LEA developed an implementation plan for ITEEA. In Table 44, we provide a summary of selected LEA implementation plans.

District/ Charter	Strategies	Measurement of Success	Target Time Period	Expected Outcomes
Alpine School District	Use of teacher trainings, student pre/post-tests & Mastery Connect	Student growth on Engineering and Design Content Areas	December, 2014 – December, 2015	Student growth on the pre-post assessments.
Davis & Morgan School District	Student Growth Assessments; “Train the Trainer”	Student growth on Engineering and Design Content Areas (STL; 8,9,10)	December, 2014 – June, 2015	Student growth is within one standard deviation of the national growth as indicated on the pre/post assessments.
Ogden Prep. Academy	Use of teacher trainings, student	Student growth on Engineering and	December, 2014 –	Student growth on the pre-post assessments.

	pre/post-tests & Mastery Connect	Design Content Areas	December, 2015	

Table 44. Summary of District/Charter Implementation Plans for ITEEA

Pitsco

Pitsco Education STEM curriculum is designed for 7th and 8th grade students to explore technology in today's world with an emphasis on engineering (Pitsco, Inc., 2016). Pitsco STEM curriculum provides a year-long supplementary experience for 45 minutes per day that includes hands-on and computer based experiments in self-directed and teacher-led environments. Pitsco also includes a comprehensive PD training program that seeks to ensure that teachers are prepared for this new learning paradigm. An education services manager (ESM) is assigned to each STEM program. The ESM leads a two-day face-to-face PD seminar and also makes a quarterly visit during the first year to ensure that the program is still operating smoothly. Each of the learning units designed provides opportunities for students to demonstrate the depth and breadth of their learning. Each unit of instruction includes a pre-test and post-test.

Pitsco PD workshops are structured to assist teachers with learning the delivery system, the curriculum content, and various classroom management strategies. Pitsco provides face-to-face professional development workshops. Each workshop accommodates up to 24 teachers with hands-on explorations similar to the material they will present to their students. All workshop participants will also get quarterly visits during the first year to provide any additional PD and to evaluate program fidelity. These services extend to one visit per year for the second and third year. In Table 45, we provide a summary of selected LEA implementation plans for Pitsco.

District/ Charter	Strategies	Expected Outcomes
Canyons School District	This technology will be embedded in lesson plans focusing on Standard 9 of Exploring Technology.	Students will have increased interest in STEM

	Teachers will participate in professional development activities prior to January 1, 2015. Ongoing teacher collaboration is held monthly for teachers to share successes, failures and best practices. In order to prepare for deployment, Exploring Technology, math and science teams will work to ensure curriculum areas are enhancing one another.	careers, e.g. design and engineering. Students will demonstrate mastery of technology use by prototyping and producing an electric vehicle.
Kane, Beaver, Iron, Garfield, and Washington School Districts	288 Licenses that will translate into 2- 12 module station labs with all software, curriculum, equipment and data monitoring system, which will be portable and fit into two enclosed trailers provided by vendor. It is the intent of this grant to provide STEM training to the rural areas of our service region. Each portable STEM learning station would be constructed with wheels to facilitate the unloading and reloading at each school site.	1- Every rural 7th and 8th grade student will participate in 5 weeks of STEM training, and that every 7th and 8th grade student over a two year period of time will spend a total of 10 weeks using these modules. 2- To continue College and Career readiness next step planning for each student as they prepare to enter 9th grade. That will include the next leg of STEM training opportunities in each of our High Schools.
Millard and Tintic, Sevier and Wayne School Districts	Physical space preparation. STEM lab installation. Professional development seminars. Observation of class operation, informal conversations with the teacher and administration. Follow up discussions will determine the need for additional professional development or other possible support mechanisms, if necessary Contact local companies that have engineers. Invite them to be guest speakers and talk to students about possible career options in Millard County and Utah. Flyers/letter, web site, and open house/parent night	Suitable classrooms are identified and corresponding room drawings are created with environmental floor plans. Identified classrooms are fully functioning STEM labs ready for stud. & teacher use Site is operating successfully; students are on target with scope and sequence; no challenges are impacting learning or lab operation Students connect the curriculum experience to local employers and job opportunities Students demonstrate the ability to effectively use teamwork to complete

		curriculum activities, demonstrate clear written and oral communication, engage in critical thinking related to curriculum activities, and problem solving related to curriculum activities
Weillenmann School of Discovery, Charter School	Engage & motivate students using STEM activities that relate to CTE Intro. Technology & Engineering Goals	Specific outcomes are provided per student project. For example: Unconventional Flight: 1. Students will build and fly a tetrahedron kite, they apply geometry and engineering while investigating the relationship between size and lift, calculate area and volume, and even design and build their own kite. 2. Students build and launch hot-air balloons. In the process, they approximate surface area and analyze the flight of their balloon. 3. Students compete in an engineering challenge to determine who can design, build, and fly a hot-air balloon to achieve the highest altitude.

Table 45. Summary of District/Charter implementation plans for Pitsco

Project Lead the Way

Project Lead the Way (PLTW) proposed the PLTW Gateway (middle school) program that is designed for 7th and 8th grade students. Their design and modeling unit for the seventh graders and automation and robotics unit for the eighth graders are aligned with the Common Core standards and designed so that it gives students a chance to apply what they have learned in class, find unique solutions, and eventually lead with their own learning style.

PLTW has collaborated with a local university (Weber State University) to provide teachers with professional development designed to introduce the PLTW curriculum. PLTW listed three phases in their professional development program: Readiness Training, Core Training, and Ongoing Training. Readiness training is on-demand and allows teachers to explore course-specific knowledge and skills. Weber State University will provide the Core training, which teaches teachers course content and pedagogy. PLTW estimated that both Readiness and Core Training would take 44 hours to complete for each unit, totaling 88 hours for both units. Lastly, the ongoing training will provide teachers with ongoing learning experiences through many eLearning resources, live online support, and face-to-face learning opportunities to keep them up-to-date on the course and equipment changes. In Table 46, we provide a summary of selected LEA implementation plans for PLTW.

District/ Charter	Strategies	Expected Outcomes
Beehive Academy	1.a) Offer Project Lead The Way Gateway: Design and Modeling (DM) unit for the 7th grade students 1.b) Offer Project Lead The Way Gateway: Automation and Robotics (AR) unit for the 8th grade students 2.a) Connect students to local job market demands. An example activity includes students completing a scavenger hunt to discover the various types of engineers and present at least one product that was invented or innovated by each type 2.b) Provide opportunities to connect students with STEM businesses and industry. Schools will create partnership teams of outside business and industry representatives 3.a) Require identified PLTW teachers to complete Readiness Training: delivered through on-	1. Curriculum aligns with Utah 7th and 8th grade CTE, math and science standards 2. Students of all backgrounds are exposed to engineering and its impact in the global economy, as well as STEM learning and STEM career pathways 3. Students utilize the design process to solve problems and find the best solution. Students apply math and science through rigorous and relevant experiences and use industry-leading technology and modern engineering tools to solve problems while gaining skills in communication, collaboration, critical-thinking, and creativity 4. Curriculum scaffolds through activity-, project-, and problem-based learning, which provides students

	demand, asynchronous eLearning resources build a foundation of essential, course-specific knowledge and skills 3.b) Require identified PLTW teachers to complete Core Training: delivered through an immersive, face-to-face training experience designed to develop understanding of course content and pedagogy essential to course instruction 4.a) Require identified PLTW teachers to complete Readiness Training: delivered through on-demand, asynchronous eLearning resources build a foundation of essential, course-specific knowledge and skills 4.b) Require identified PLTW teachers to complete Core Training: delivered through an immersive, face-to-face training experience designed to develop understanding of course content and pedagogy essential to course instruction 4.c) Provide Ongoing Training throughout the year: via a blended learning experience consisting of eLearning resources, live online support, and face-to-face learning opportunities designed to develop a deeper understanding of course content and delivery while staying up-to-date on course and equipment changes 5.a) Gather evidence of change in student understanding: use a balanced assessment approach that includes both formative and summative strategies to continually monitor student understanding and skills of STEM subjects 5.b) Gather data to improve professional development offerings including the internal review of pre-assessments, portfolios, and surveys	with the appropriate foundational knowledge and skills needed to solve complex problems 5. Students learn of new careers previously unknown to them or thought to be unattainable 6. Students learn how to communicate effectively, work in teams, facilitate discussions, practice professional conduct, think critically, and problem-solve solutions 7. Teachers have basic technical and content knowledge prior to participating in pedagogy, skill, and knowledge enhancement training experiences 8. Teachers have an understanding of course content and pedagogy essential to course instruction 9. Teachers will be able to share expertise and experiences with national PLC network to improve instructional practice and student learning 10. Teachers have a working knowledge of the technologies used in PLTW Gateway programs 11. Teachers have an understanding of course content and pedagogy essential to course instruction 12. Curriculum is continuously improved and updated 13. Teacher training is continuously improved and enhanced 14. Evaluators have necessary information to perform pre-test/post-test surveys and assessment on quality of PLTW implementation 15. In DM, students apply the design process to solve problems and understand the influence of creativity and innovation in their lives. They work in teams to design a playground and furniture, capturing research and ideas in their engineering notebooks. Using Autodesk® design software,

	completed by trained teachers 6.a) Per grant application, LEA will work collaboratively with GOED/The STEM AC, and Utah State Office of Education, and evaluators to provide student information from PLTW's Learning Management System (LMS) as needed to support evaluation efforts 7a) Implement Design and Modeling unit curriculum for 7th grade students 7.b) Utilize necessary equipment for Design and Modeling unit for 7th grade students 7.c) Implement Automation and Robotics unit curriculum for 8th grade students 7.d) Utilize necessary equipment for Automation and Robotics unit for 8th grade students 8.) Per grant application, LEA will work collaboratively with GOED/The STEM AC, and Utah State Office of Education, and evaluators to provide student information from PLTW's Learning Management System (LMS) as needed to support evaluation efforts 9.a) Offer Project Lead the Way Gateway: Design and Modeling unit for the 7th grade students 9.b) Offer Project Lead the Way Gateway: Automation and Design unit for the 8th grade students 9.c) By offering Project Lead The Way Gateway DM/AR Units, provide access to additional units that are focused on computer science, information technology and programming topics	students create a virtual image of their designs and produce a portfolio to showcase their innovative solutions 16. In AR, students trace the history, development, and influence of automation and robotics as they learn about mechanical systems, energy transfer, machine automation, and computer control systems. Students use the VEX Robotics® platform to design, build, and program real-world objects such as traffic lights, toll booths, and robotic arms 17. Evaluators have necessary information to perform pre-test/post-test surveys and assessment on quality of PLTW implementation 18. Curriculum is aligned with CTE information technology standards 19. Students are exposed to digital media, computer science, and information technology 20. Students develop and modify digital media assets, utilize numerous software, web, and digital design tools, develop proficiency with file management and online services, work with various hardware and software platforms, and work on design, drafting, and elements of coding through the robotics equipment 21. Curriculum scaffolds learning with activities, projects, and problems, which provides students with the appropriate foundational knowledge and skills needed to solve complex problems
Davis District & Morgan District	Student Growth Assessments; "Train the Trainer"	Student growth is within one standard deviation of the national growth as indicated on the pre/post assessments.
Jordan	32 hour course split into 5 days of	Integration of new concepts into

District	training	current courses
Uintah District	1.a) Offer Project Lead the Way Gateway: Design and Modeling (DM) unit for the 7th grade students 1.b) Offer Project Lead the Way Gateway: Automation and Robotics (AR) unit for the 8th grade students 2.a) Connect students to local job market demands. An example activity includes students completing a scavenger hunt to discover the various types of engineers and present at least one product that was invented or innovated by each type 2.b) Provide opportunities to connect students with STEM businesses and industry. Schools will create partnership teams of outside business and industry representatives 3.a) Require identified PLTW teachers to complete Readiness Training: delivered through on-demand, asynchronous eLearning resources build a foundation of essential, course-specific knowledge and skills 3.b) Require identified PLTW teachers to complete Core Training: delivered through an immersive, face-to-face training experience designed to develop understanding of course content and pedagogy essential to course instruction 4.a) Require identified PLTW teachers to complete Readiness Training: delivered through on-demand, asynchronous eLearning resources build a foundation of essential, course-specific knowledge and skills 4.b) Require identified PLTW teachers to complete Core Training: delivered through an immersive, face-to-face training experience designed to develop understanding of course content and pedagogy	1. Curriculum aligns with Utah 7th and 8th grade CTE, math and science standards 2. Students of all backgrounds are exposed to engineering and its impact in the global economy, as well as STEM learning and STEM career pathways 3. Students utilize the design process to solve problems and find the best solution. Students apply math and science through rigorous and relevant experiences and use industry-leading technology and modern engineering tools to solve problems while gaining skills in communication, collaboration, critical-thinking, and creativity 4. Curriculum scaffolds through activity-, project-, and problem-based learning, which provides students with the appropriate foundational knowledge and skills needed to solve complex problems 5. Students learn of new careers previously unknown to them or thought to be unattainable 6. Students learn how to communicate effectively, work in teams, facilitate discussions, practice professional conduct, think critically, and problem-solve solutions 7. Teachers have basic technical and content knowledge prior to participating in pedagogy, skill, and knowledge enhancement training experiences 8. Teachers have an understanding of course content and pedagogy essential to course instruction 9. Teachers will be able to share expertise and experiences with national PLC network to improve instructional practice and student learning

	essential to course instruction 4.c) Provide Ongoing Training throughout the year: via a blended learning experience consisting of eLearning resources, live online support, and face-to-face learning opportunities designed to develop a deeper understanding of course content and delivery while staying up-to-date on course and equipment changes 5.a) Gather evidence of change in student understanding: use a balanced assessment approach that includes both formative and summative strategies to continually monitor student understanding and skills of STEM subjects 5.b) Gather data to improve professional development offerings including the internal review of pre-assessments, portfolios, and surveys completed by trained teachers 6.a) Per grant application, LEA will work collaboratively with GOED/The STEM AC, and Utah State Office of Education, and evaluators to provide student information from PLTW's Learning Management System (LMS) as needed to support evaluation efforts 7.a) Implement Design and Modeling unit curriculum for 7th grade students 7.b) Utilize necessary equipment for Design and Modeling unit for 7th grade students 7.c) Implement Automation and Robotics unit curriculum for 8th grade students 7.d) Utilize necessary equipment for Automation and Robotics unit for 8th grade students 8.a) Per grant application, LEA will work collaboratively with GOED/The STEM AC, and Utah	10. Teachers have a working knowledge of the technologies used in PLTW Gateway programs 11. Teachers have an understanding of course content and pedagogy essential to course instruction 12. Curriculum is continuously improved and updated 13. Teacher training is continuously improved and enhanced 14. Evaluators have necessary information to perform pre-test/post-test surveys and assessment on quality of PLTW implementation 15. In DM, students apply the design process to solve problems and understand the influence of creativity and innovation in their lives. They work in teams to design a playground and furniture, capturing research and ideas in their engineering notebooks. Using Autodesk® design software, students create a virtual image of their designs and produce a portfolio to showcase their innovative solutions 16. In AR, students trace the history, development, and influence of automation and robotics as they learn about mechanical systems, energy transfer, machine automation, and computer control systems. Students use the VEX Robotics® platform to design, build, and program real-world objects such as traffic lights, toll booths, and robotic arms 17. Evaluators have necessary information to perform pre-test/post-test surveys and assessment on quality of PLTW implementation 18. Curriculum is aligned with CTE information technology standards 19. Students are exposed to digital media, computer science, and information technology 20. Students develop and modify digital media assets, utilize numerous

	State Office of Education, and evaluators to provide student information from PLTW's Learning Management System (LMS) as needed to support evaluation efforts 9.a) Offer Project Lead The Way Gateway: Design and Modeling unit for the 7th grade students 9.b) Offer Project Lead the Way Gateway: Automation and Design unit for the 8th grade students 9.c) By offering Project Lead The Way Gateway DM/AR Units, provide access to additional units that are focused on computer science, information technology and programming topics	software, web, and digital design tools, develop proficiency with file management and online services, work with various hardware and software platforms, and work on design, drafting, and elements of coding through the robotics equipment 21. Curriculum scaffolds learning with activities, projects, and problems, which provides students with the appropriate foundational knowledge and skills needed to solve complex problems
Weber District	PLTW teacher trainings along with 6 PD dates throughout the year	Students will register for more STEM classes, as well as be more successful in the ones they already have
Duchesne District	1.a) Offer Project Lead the Way Gateway: Design and Modeling (DM) unit for the 7th grade students 1.b) Offer Project Lead the Way Gateway: Automation and Robotics (AR) unit for the 8th grade students 1.c) Offer Project Lead the Way Gateway: Medical Detectives (MD) unit for the 8th grade students 2.a) Connect students to local job market demands. An example activity includes students completing a scavenger hunt to discover the various types of engineers and present at least one product that was invented or innovated by each type 2.b) Provide opportunities to connect students with STEM businesses and industry. Schools will create partnership teams of outside business and industry representatives 3.a) Require identified PLTW teachers to complete Readiness Training: delivered through on-demand, asynchronous eLearning resources build a foundation of	1. Curriculum aligns with Utah 7th and 8th grade CTE, math and science standards 2. Students of all backgrounds are exposed to engineering and its impact in the global economy, as well as STEM learning and STEM career pathways 3. Students utilize the design process to solve problems and find the best solution. Students apply math and science through rigorous and relevant experiences and use industry-leading technology and modern engineering tools to solve problems while gaining skills in communication, collaboration, critical-thinking, and creativity 4. Curriculum scaffolds through activity-, project-, and problem-based learning, which provides students with the appropriate foundational knowledge and skills needed to solve complex problems 5. Students learn of new careers previously unknown to them or

	essential, course-specific knowledge and skills 3.b) Require identified PLTW teachers to complete Core Training: delivered through an immersive, face-to-face training experience designed to develop understanding of course content and pedagogy essential to course instruction 4.a) Require identified PLTW teachers to complete Readiness Training: delivered through on-demand, asynchronous eLearning resources build a foundation of essential, course-specific knowledge and skills 4.b) Require identified PLTW teachers to complete Core Training: delivered through an immersive, face-to-face training experience designed to develop understanding of course content and pedagogy essential to course instruction 4.c) Provide Ongoing Training throughout the year: via a blended learning experience consisting of eLearning resources, live online support, and face-to-face learning opportunities designed to develop a deeper understanding of course content and delivery while staying up-to-date on course and equipment changes 5.a) Gather evidence of change in student understanding: use a balanced assessment approach that includes both formative and summative strategies to continually monitor student understanding and skills of STEM subjects 5.b) Gather data to improve professional development offerings including the internal review of pre-assessments, portfolios, and surveys completed by trained teachers 6.a) Per grant application, LEA will	thought to be unattainable 6. Students learn how to communicate effectively, work in teams, facilitate discussions, practice professional conduct, think critically, and problem-solve solutions 7. Teachers have basic technical and content knowledge prior to participating in pedagogy, skill, and knowledge enhancement training experiences 8. Teachers have an understanding of course content and pedagogy essential to course instruction 9. Teachers will be able to share expertise and experiences with national PLC network to improve instructional practice and student learning 10. Teachers have a working knowledge of the technologies used in PLTW Gateway programs 11. Teachers have an understanding of course content and pedagogy essential to course instruction 12. Curriculum is continuously improved and updated 13. Teacher training is continuously improved and enhanced 14. Evaluators have necessary information to perform pre-test/post-test surveys and assessment on quality of PLTW implementation 15. In DM, students apply the design process to solve problems and understand the influence of creativity and innovation in their lives. They work in teams to design a playground and furniture, capturing research and ideas in their engineering notebooks. Using Autodesk® design software, students create a virtual image of their designs and produce a portfolio to showcase their innovative solutions 16. In AR, students trace the history, development, and influence of

	work collaboratively with GOED/The STEM AC, and Utah State Office of Education, and evaluators to provide student information from PLTW's Learning Management System (LMS) as needed to support evaluation efforts 7.a) Implement Design and Modeling unit curriculum for 7th grade students 7.b) Utilize necessary equipment for Design and Modeling unit for 7th grade students 7.c) Implement Automation and Robotics unit curriculum for 8th grade students 7.d) Utilize necessary equipment for Automation and Robotics unit for 8th grade students 7.e) Implement Medical Detective unit curriculum for 8th grade students 7.f) Utilize necessary equipment for Medical Detective unit for 8th grade students 8.a) Per grant application, LEA will work collaboratively with GOED/The STEM AC, and Utah State Office of Education, and evaluators to provide student information from PLTW's Learning Management System (LMS) as needed to support evaluation efforts 9.a) Offer Project Lead the Way Gateway: Design and Modeling unit for the 7th grade students 9.b) Offer Project Lead the Way Gateway: Automation and Design unit for the 8th grade students 9.c) Offer Project Lead the Way Gateway: Medical Detective unit for the 8th grade students 9.d) By offering Project Lead The Way Gateway DM/AR/MD Units, provide access to additional units that are focused on computer science,	automation and robotics as they learn about mechanical systems, energy transfer, machine automation, and computer control systems. Students use the VEX Robotics® platform to design, build, and program real-world objects such as traffic lights, toll booths, and robotic arms 17. Evaluators have necessary information to perform pre-test/post-test surveys and assessment on quality of PLTW implementation 18. Curriculum is aligned with CTE information technology standards 19. Students are exposed to digital media, computer science, and information technology 20. Students develop and modify digital media assets, utilize numerous software, web, and digital design tools, develop proficiency with file management and online services, work with various hardware and software platforms, and work on design, drafting, and elements of coding through the robotics equipment 21. Curriculum scaffolds learning with activities, projects, and problems, which provides students with the appropriate foundational knowledge and skills needed to solve complex problems

	information technology and programming topics	
American International School	Implementation of the PLTW Gateway courses Design and Modeling and Automation and Robotics as trimester long elective courses for 7^{th} & 8^{th} grade students Development of student's 21^{st} century learning skills are inherent in the PLTW curriculum, which requires students to complete group-oriented problem solving activities. Students enrolled in the PLTW courses will present to the community, parents and their peers at the celebration of learning hosted at the end of each trimester. The STEM Director at AISU will continue to foster relationship with industry professionals, including parents and community members Instructors for the PLTW Gateway course will complete Online Readiness Training and Core training before Jan. 1^{st}. Teacher will gain access to a national Gateway professional learning community. AISU has established a learning community of math, science and CTE teacher who meet bi-weekly to discuss best practices and strategies. PLTW Gateway curriculum incorporates both formative and summative assessment strategies to monitor students understanding of STEM subjects. All AISU students participate in state standardized testing as well as NWEA MAP Testing. The school will make this data as well as data from PLTW's Learning Management System available to external evaluators. AISU will work collaboratively with GOED/The STEM AC, and USBE to	- More than 30 % of 8^{th} students will participate in the elective course - 7th grade CTE intro will be enhanced with PLTW gateway lessons - 98 % of students will show improvement on the post-test assessment -98 % of students who register for the PLTW course will successfully complete it - 98% of students will show 21^{st} century skills as evaluated by the external evaluator - 98 % of students will actively participate in presenting to the AISU community during the Celebrations of Learning - A minimum of 2 guest speakers will present during the trimester - Each student will participate in 2 work-based learning opportunities through the trimester All instructors for the PLTW courses will complete the Readiness and Core training prior to the implementation of the course. Teachers will be able to share expertise and experiences with national PLC network to improve instructional practice and student learning. Teachers will be able to share expertise and experiences within the AISU community. Teacher training and curriculum is continuously updated. 98% of students will improve in pre and posttest incorporated in the curriculum 98% of students will improve in outside measure of growth CTE students will develop an increased awareness of STEM

	provide student learning information using unique identifying numbers. Because AISU is in its first year of operation this is our largest area of need. To effectively implement the PLTW Gateway courses we will work with the PLTW staff to review specific equipment needs. Additionally, AISU is committed to building out the facilities and infrastructure needed to support these programs	industries and careers. Student growth in STEM skills, exposure to STEM careers, development of student's 21^{st} century learning skills.
Alpine District	Student growth in STEM skills, exposure to STEM careers, development of student's 21^{st} century learning skills.	Student growth on the pre-post assessments.

Table 46. Summary of District/Charter implementation plans for PLTW

STEM Academy

STEM Academy is a project-based curriculum that contains extensive online resources. The curriculum also includes many hands-on activities designed to bring "real-world" experience to students. The curriculum "includes career exploratory pathways for agriculture, architecture, aviation, biotechnology, coding, electronics, energy, engineering, design, food science, information technology, manufacturing, medical, and sustainability and transportation (STEM 101, 2016). In Table 47, we provide a summary of selected LEA implementation plans for STEM Academy.

District/ Charter	Strategies	Measurement of Success	Expected Outcomes
Salt Lake City School District	Curriculum Implementation, Student Electronic Survey; Formative and Summative Student assessments, course completion records, student	*At least 60% of students in the 7^{th} and 8^{th} grade class will report they plan to pursue a career in a STEM field; *At least 50% of the students in	Students in the 7^{th} and 8^{th} grade class will report that they plan to pursue a career in a STEM field; Students in the 7^{th} and 8^{th} grade

	project evaluation rubrics, Student and Teacher surveys; Professional Development sessions with the STEM Academy (in person and virtual), project records, course completion records, Student and Teacher surveys	the 7th and 8th grade class will report that they plan to enroll in post-secondary education (including vocational) in a STEM field	class will report that they plan to enroll in post-secondary education (including vocational) in a STEM field; Students in the 7th and 8th grade class will report that they are planning to enroll in a four-year university; *At least 80% of the students will, by the end of the year, successfully complete the appropriate content/ courses and demonstrate these skills on their project assignments; *Teachers will rate at least 50% of the students in the course as having 21st Century employability skills
Tooele School District	Utilize curriculum mapping practices (RubiconAtlas online tool) to align STEM Academy content to maps for the identified classes; Update the map for the 2015/16 school year to implement with three Pilot	Completed map with STEM Academy units aligned to CTE core; Completed map with STEM Academy units aligned to state math & science core; 60% of students in 7th and 8th grade who participated in the STEM Academy online content will be	Completed map that can be utilized for full implementation of STEM Academy content in CTE Intro, Exploring Tech and Intro to Communications courses; Completed map that can be utilized for full

	School Tech Ed and CTE Intro technology education teachers; Utilize work-based learning network specialists to provide guest speakers and field trips that align to CTE core content; Implement STEM 101 Corporate Connections program within STEM coursework; Implement content from STEM Academy that is aligned to 21st Century learning skills. Skills in STEM Academy aligned to 21st Century skills include: verbal & written communication, interpersonal skills, teamwork skills, initiative, flexibility, computer skills, analytical skills and organizational skills; Implement behavioral rubrics to evaluate student growth in 21st century skills; Train the pilot group in use of the online tool and an overview of all the content on the site; Implement in-person staff development with STEM Academy and CTE pilot group that provides a clear understanding of use	able to identify a STEM Career they are interested in pursuing; 40% of students in 7th/8th grade will report they plan to enroll in an identified STEM course in high schools and/or 8th grade course; 30% of the students will enroll in a CTE course in 8th and/or 9th grade that is STEM based; Students will successfully demonstrate growth in utilization of 21st Century Skills as measured by a behavioral rubric; CTE teachers utilizing STEM Academy content as outlined in the curriculum map; Teachers actively participating in online follow-up blog sessions to support enhanced use of online tool; Teachers utilizing additional components of STEM Academy content in classes; 100% of the pilot team actively implementing STEM 101 as part of course content; 90% of implementation team implementing STEM 101 into curriculum as outlined by the curriculum map; 100% of teachers	implementation of STEM Academy content in CTE Intro, Exploring Tech and Intro to Communications courses; Increased numbers of students aware of careers in STEM field.; Students knowing the pathway of high school courses that are aligned to STEM careers; Increased #s of students taking STEM related courses in 8th and high school grades; Students will demonstrate growth in at least 50% of the 21st Century Skills identified under strategies during the semester course; 100% of pilot teachers implementing STEM Academy content as outlined on the curriculum map; 90% of full implementation teachers implementing STEM Academy content as outlined on the curriculum map; Content fully implemented by a core pilot team prior to full implementation; Teachers utilizing

	of the online tool, an overview of content and practice in use of materials found on the curriculum map; Provide online follow-up sessions to answer teacher questions and train on any new content; Pilot curriculum during second semester of 2014/15 school year with a leadership team of 3 teachers to support effective implementation in designated CTE Intro classrooms; Initiate STEM 101 in designated 7th and 8th grade Exploring Technology, Intro to Communications and CTE Intro classrooms in the 2015/16 school year; Work with STEM academy to utilize pre/posttests as part of STEM Academy implementation to monitor student growth; Utilize STEM Academy metrics to monitor online content usage; Conduct student/teacher satisfaction surveys to determine quality of product and impact on student interest in STEM courses and careers; Set up an	implementing pre/ post-tests as part of curriculum implementation; Easily accessible reporting from STEM academy; Survey designed collaboratively by vendor and LEA that assess quality of product and student interest in STEM	STEM 101 content as an active part of their daily instruction; Clear data to assess the quality of implementation, content, and impact on student interest in STEM careers; Increased awareness and support from stakeholders of STEM training programs; Increased enrollment of students in STEM CTE courses

	ongoing measurement to determine if students who participated in the STEM Academy implementation took increased math/science and STEM CTE courses; Hold a school or district CTE, technology and engineering fair to showcase student projects and learning to all stakeholders		

Table 47. Summary of District/Charter implementation plans for PLTW

Methods

The evaluation tools that were deployed to measure the effectiveness of the 4 CTE products, ITEEA, Pitsco, Project Lead the Way, and STEM Academy, included student and teacher perception surveys, pre and post assessments developed by the vendors, and the Utah summative[1] SAGE assessment. We first discuss the survey methods, followed by a consideration of quantitative assessments.

Survey Methods

The pre and post surveys measured students' and teachers' perceptions of the extent to which their classroom atmosphere fostered student growth in a subset of 21st century skills. We also measured teachers' perceptions regarding the quality of the CTE product chosen by their

[1] Summative assessments usually take the form of an end of unit or end of year exam providing a snapshot of a students' knowledge on the topic for which the assessment was written.

Local Education Agency (LEA). In particular, the surveys measured the extent to which the participants' classrooms fostered critical thinking, collaboration, and innovation skills. In addition, teachers were asked to describe their experience with the product their schools chose, and the professional development provided by that vendor.

To obtain survey data, letters of information were drafted and sent to each participating LEA along with a link to the appropriate survey. These letters of information included an option to opt-out. Once we received these opt-out letters, a list was created so that these individuals' data would not be included in the analysis presented below. Thus, these names were removed prior to completing any analysis of survey data related to this program.

These surveys were analyzed for frequency counts of all quantitative variables. All qualitative survey responses were analyzed using an open coding method, then summarized into appropriate categories. Appropriate tables and graphs were then created to display the qualitative and quantitative data summaries.

Assessment Methods

The end goal for the evaluation of this grant program was to analyze participating students' SAGE scores. Thus, a plan was developed to collect students' state school IDs (SSIDs) which could then be sent to the Utah State Board of Education (USBE), who would provide these students' SAGE scores. Many challenges were presented in the data collection process, but before these are described, we describe the issues regarding the validity of the SAGE and vendor assessments toward student achievement in these CTE courses.

There are many reasons to consider a particular set of measurements to assess student outcomes, however, before choosing a specific metric, the validity of these measurements must be ascertained (AERA, 2014). The four participating vendors in this evaluation have not provided any validity data regarding the pre and post assessments that were administered to students, though this information was requested. In addition to data quality issues, it is unclear whether students' SAGE scores are a valid measure of student outcomes related to this program. What follows is a short discussion on assessment validity in relation to this evaluation.

Assessments contain a series of measurements. A specific "measurement is valid to the same degree that its results approximate students' true achievement levels (Cangelosi J. S., 2003)." Since no assessment can perfectly measure students' true achievement levels, we anticipate some error, but attempt to minimize the error by checking the validity of the assessment. Two conditions are necessary to ensure validity, they are relevance and reliability.

A test prompt is only relevant to measuring student achievement if it pertains to the specified learning levels and objectives contained in the assessment (Cangelosi J. S., 2003; AERA, 2014). Thus, measurement of student achievement in a particular course is proportional to the degree to which the administered assessment is relevant to the course objectives and learning levels. While contemporary CTE curriculum shares a number of objectives with the Core curriculum assessed by the SAGE instrument, it is unclear to what degree the four participating vendors' products contain a critical mass of material necessary to ensure a valid measurement of student achievement on these Core objectives. Further, the learning levels contained within these four products may not be relevant to those measured on the SAGE assessment. Without data showing the degree to which the four CTE products meet SAGE objectives and learning levels, no conclusion should be drawn regarding student achievement on the SAGE assessment.

With this in mind, measurement of student outcomes in CTE courses may require assessments that have been designed for this specific purpose. Three of the four vendors provided pre and post assessments specifically designed for their curricula. However, no data has been provided regarding the reliability of these assessments.

Reliability is a second necessary condition to guarantee validity. An assessment tool is reliable if it has internal consistency and scorer consistency (Cangelosi, 2003). Thus, assessing student outcomes related to new CTE curriculum must be analyzed for both internal consistencies among test items, and for scorer consistency. The latter of these is easy to analyze if the assessment is multiple choice and administered by computer, while the former is more labor intensive and may require a set of assessment data to identify inconsistencies. Without reliability data, no conclusions should be drawn from the vendor pre and post assessments regarding student achievement in the 4 participating CTE courses.

Data Quality

A change in data standards and collection procedures is necessary to obtain the required data to analyze outcomes of interest. In order to obtain SAGE scores of participating students, school districts must provide researchers with participating students' state student identifiers (SSIDs). Though all participating students SSIDs are not necessary, a large enough sample must be provided to ensure that all groups are well represented. Because we received too small a sample of SSIDs, SAGE score analysis would not be a valid measure of the effectiveness of the four CTE products on student achievement.

If participating school districts had provided a sufficient number of students' SSIDs, SAGE score analysis would, nevertheless, be an invalid measure of student achievement with respect to the evaluated CTE courses due to incomplete or unavailable vendor data. For example, if we do not know to what degree students' used the products provided by their CTE vendor, then we have no way to correlate product usage with student outcomes. Thus, data showing students' level of use is necessary, but was not provided.

Of the data that was delivered, two of the four vendors provided student level data listing students who had taken a pre or post assessment, one vendor provided no data, and the last vendor provided only the number of students who accessed their online content. In total, this accounted for just over 10% of the students who received licenses, but did not give any indication as to the level at which these students used their respective products. Thus, a correlation analysis between usage and student outcomes is not currently possible. In addition, given the small sample of students with no demographic data, it is not currently possible to tell whether this would be a representative sample of the overall population participating in the CTE grant program. Therefore, the validity of SAGE score analysis is not measurable, and hence not usable as a tool in this evaluation.

Results

In this evaluation study, surveys were used to measure teachers' and students' perceptions of the CTE curriculum and its implementation. Specifically, we sought to measure teachers' perceptions of the professional development (PD) furnished by each vendor, perceptions of the efficacy of the curriculum toward student achievement, and the level to which the interdisciplinary intrinsic nature of the provided CTE curriculum caused cross-discipline collaboration and fostered a 21st century classroom atmosphere. For students, we sought to measure whether these CTE courses increased students' development of a subset of 21st century skills, included in the overarching areas of "Life and Career Skills" and "Learning and Innovation Skills (The Partnership for 21st Century Learning, 2016; National Education

Association, 2016).” We also sought to understand the extent to which these CTE courses increased their interest and awareness in STEM careers.

In addition to students’ perceptions of the CTE programs, we were interested in their academic achievement relative to the Utah CTE Core curriculum, and the Core curriculum assessed by the summative SAGE assessment. As noted in the Methods section of this report, both vendor and SAGE score analysis may not be valid toward an assessment of student achievement. For completeness, we included a summary of students’ vendor pre and post assessments. Unfortunately, data quality issues preempted the inclusion of a SAGE score analysis; thus, it has been excluded. Before presenting the summaries of survey and vendor assessment data, we give some descriptive statistics regarding the population of students and teachers involved in this study.

Descriptive Statistics

Pitsco and STEM Academy provided usage data in the form of student pre and post assessments, while Project Lead the Way provided summary usage data. All of these data sources only include students who logged on to their respective vendor’s website to take an assessment. ITEEA did not provide any data. Since many of the products associated with this curriculum are of a “hands-on” variety, minimal computer access should be expected, thus the low “percentage of licenses with assessment data” should not be viewed as non-usage, but only as the percentage of students who took an online assessment related to their product. Further, it should be noted that STEM Academy users had problems logging in to the online portion of their product until December, and some students never gained access. Thus, usage data for this product is tenuous at best.

Assessment Data	ITEEA	Pitsco	Project Lead the Way	STEM Academy	Totals
Number of licenses awarded	24,418	789	5,629	18,017	**48,853**
Number of K-12 Students with assessment data	Not Provided	265	3209	1621	**5095**
Number of LEAs with assessment data	Not Provided	4	8	13	**25**
Number Schools with assessment data	Not Provided	4	13	27	**44**
Percentage of licenses with assessment data	Not Provided	33.59 %	57.01%	9.00%	**10.43 %**

Table 48. Product assessment data

In the teacher perceptions survey, we asked teachers to describe the CTE product their district chose and the classes to which they would administer this product. We note that with only 40 responses to the teacher survey, the following data may not be representative of the cohorts of schools. The average class size among respondents was approximately 33 students per teacher. The teachers who responded represented approximately 7,345 students. 17 teachers taught 7th grade, 8 teachers taught 8th grade, and 15 teachers taught both 7th and 8th grade (see Table 48).

The student perception survey had 2,385 responses. The survey asked students to describe the atmosphere within their CTE classroom. Specifically, it asked them to describe how much they were able to interact with other students, decide how and what they learned, and whether they could exhibit critical thinking skills. No demographic data was requested.

Quantitative Assessment

Table 49 provides the frequency of statistically significant increases in student achievement relative to these assessments. We note here the wide range of subjects assessed, which can be seen by viewing the assessment titles. In total, there were 37 assessments given over two products, each covering a different subject.

Comparison of Pre and Post Assessments	ITEEA	STEM Academy	PLTW	Pitsco
Statistically Significant Increase in Score	No Data	5	No Data	20
Total Number of Assessments	No Data	8	No Data	29
Percent of Assessments Statistically Significant	No Data	0.625	No Data	0.689

Table 49. Comparison of pre and post-assessments

Table 50 gives a summary of the vendor pre and post assessments administered to a subset of participating students. The table includes the number of students' who took each pre and posttest, their average score, their average gain score, and a paired t-test with its accompanying p-value and effect size. Note that only STEM Academy and Pitsco provided student level assessment data.

STEM Academy								
7th Grade								
Assessment Name	**Descriptive Statistic**	**PreScore**	**PostScore**	**Gain Score**		***t*-statistic**	***p*-value**	**Effect Size (Cohen's D)**
7th Grade Pre/Post	**Mean**	28.28	35.1	6.82		15.7	7.7E-41	0.91
	Std. Deviation	7.89	10.1	7.48				
	N	297	297					
	Max Points Possible	60	60					
8th Grade								
Assessment Name	**Descriptive Statistic**	**PreScore**	**PostScore**	**Gain Score**		***t*-statistic**	***p*-value**	**Effect Size (Cohen's D)**
Explore Engineering	**Mean**	2.14	2.86	0.71		2.66	0.015	0.58

	Std. Deviation	0.96	0.65	1.23			
	N	21	21				
	Max Points Possible	4	4				
History of Engineering	**Mean**	3.44	3.57	0.13	1.49	0.14	0.18
	Std. Deviation	0.73	0.69	0.72			
	N	70	70				
	Max Points Possible	4	4				
Medical Technology	**Mean**	2.6	2.65	0.05	0.37	0.72	0.08
	Std. Deviation	0.5	0.49	0.6			
	N	20	20				
	Max Points Possible	4	4				
Microsoft Kodu	**Mean**	5.6	6.31	0.71	2.25	0.03	0.34
	Std. Deviation	2.08	2.49	2.08			
	N	44	44				
	Max Points Possible	10	10				
Problem Solving	**Mean**	1.51	1.5	-0.01	0.13	0.9	0.01
	Std. Deviation	0.65	0.7	0.79			
	N	92	92				
	Max Points Possible	3	3				
Discovering Sketching and Drafting	**Mean**	5.93	6.69	0.76	4.25	0.0000635	0.5
	Std. Deviation	2.27	2.71	1.52			
	N	72	72				

	Max Points Possible	10	10				
Transportation Technology	**Mean**	1.66	14.05	12.4	21.3	3.93E-29	2.78
	Std. Deviation	0.58	4.85	4.46			
	N	59	59				
	Max Points Possible	23	23				

Pitsco

Assessment Name	Descriptive Statistic	PreScore	PostScore	Gain Score	t-statistic	p-value	Effect Size (Cohen's D)
Alternative Energy 3.4.1	**Mean**	16.28	63.91	19.57	5.75	7.40E-07	0.85
	Std. Deviation	63.91	19.49	23.09			
	N	46	46				
	Max Points Possible	100	100				
Alternative Energy 3.4.2	**Mean**	10.56	61.33	17.33	2.90	0.0116	0.75
	Std. Deviation	10.56	25.32	23.14			
	N	15	15				
	Max Points Possible	100	100				
Biotechnology 3.0.2	**Mean**	36.84	66.05	29.21	8.15	8.93E-10	1.32
	Std. Deviation	16.46	19.66	22.10			
	N	38	38				
	Max Points Possible	100	100				
CADD 3.3.2	**Mean**	42.94	40.59	-2.35	0.50	0.6262	0.12
	Std. Deviation	16.11	17.13	19.54			

	N	17	17				
	Max Points Possible	100	100				
CNC Manufacturing 3.1.1	**Mean**	49.42	65.22	15.80	5.42	8.54E-07	0.65
	Std. Deviation	19.01	21.39	24.22			
	N	69	69				
	Max Points Possible	100	100				
Assessment Name	**Descriptive Statistic**	**PreScore**	**PostScore**	**Gain Score**	**t-statistic**	**p-value**	**Effect Size (Cohen's D)**
Composites 3.0.1	**Mean**	NA	NA	NA	NA	NA	NA
	Std. Deviation	NA	NA	NA			
	N	2	2				
	Max Points Possible	100	100				
Eco-Architecture 3.0.3	**Mean**	43.85	50.00	6.15	0.74	0.4719	0.21
	Std. Deviation	18.50	24.83	29.87			
	N	13	13				
	Max Points Possible	100	100				
Electricity 3.0.0a	**Mean**	45.50	59.00	13.50	2.24	0.0376	0.50
	Std. Deviation	19.86	29.89	27.00			
	N	20	20				
	Max Points Possible	100	100				
Energy, Power & Mechanics 3.1.1	**Mean**	53.54	0.00	19.85	7.80	7.12E-11	0.97
	Std. Deviation	17.18	20.71	20.50			
	N	65	65				

	Max Points Possible	100	100				
Engineering Bridges 3.0.3	**Mean**	46.15	72.00	25.85	9.12	3.43E-13	1.13
	Std. Deviation	18.43	18.97	22.84			
	N	65	65				
	Max Points Possible	100	100				
Engineering Towers 3.0.3	**Mean**	53.49	79.77	26.28	8.94	2.85E-11	1.36
	Std. Deviation	18.24	15.66	19.28			
	N	43	43				
	Max Points Possible	100	100				
Engines 3.0.2	**Mean**	30.00	49.17	19.17	2.21	0.0489	0.64
	Std. Deviation	12.79	28.43	29.99			
	N	12	12				
	Max Points Possible	100	100				
Flight Technology 3.2.2	**Mean**	34.42	60.00	25.58	7.56	2.30E-09	1.15
	Std. Deviation	15.93	23.90	22.18			
	N	43	43				
	Max Points Possible	100	100				
Flight Technology 3.3.1	**Mean**	35.45	61.82	26.36	3.39	0.0069	1.02
	Std. Deviation	16.35	24.42	25.80			
	N	11	11				
	Max Points Possible	100	100				

Forces 3.0.3	**Mean**	35.95	74.76	38.81	10.75	1.68E-13	1.66
	Std. Deviation	15.47	20.98	23.40			
	N	42	42				
	Max Points Possible	100	100				
Forensic Science 3.1.2	**Mean**	NA	NA	NA	NA	NA	NA
	Std. Deviation	NA	NA	NA			
	N	NA	NA				
	Max Points Possible	100	100				
Future Fuels 3.0.4	**Mean**	51.82	66.36	14.55	1.48	0.1705	0.45
	Std. Deviation	17.79	28.03	32.67			
	N	11	11				
	Max Points Possible	100	100				
Home Makeover 3.2.2	**Mean**	56.55	81.90	25.34	8.61	6.72E-12	1.13
	Std. Deviation	17.53	18.11	22.42			
	N	58	58				
	Max Points Possible	100	100				
Intelligent Homes 3.0.2	**Mean**	50.00	71.88	21.88	3.65	0.0024	0.91
	Std. Deviation	23.38	18.34	24.01			
	N	16	16				
	Max Points Possible	100	100				
Light & Lasers 3.1.2	**Mean**	28.75	58.13	29.38	4.28	6.55E-04	1.07
	Std. Deviation	14.55	24.82	27.44			

	N	16	16				
	Max Points Possible	100	100				
Plastics & Polymers 3.1.1	**Mean**	53.97	75.00	21.03	9.44	6.37E-14	1.14
	Std. Deviation	18.30	16.35	18.38			
	N	68	68				
	Max Points Possible	100	100				
Assessment Name	**Descriptive Statistic**	**PreScore**	**PostScore**	**Gain Score**	**t-statistic**	**p-value**	**Effect Size (Cohen's D)**
Practical Skills 3.0.2	**Mean**	40.00	58.00	18.00	1.55	0.1949	0.70
	Std. Deviation	22.36	29.50	25.88			
	N	5	5				
	Max Points Possible	100	100				
RCA (120)	**Mean**	NA	NA	NA	NA	NA	NA
	Std. Deviation	NA	NA	NA			
	N	NA	NA				
	Max Points Possible	100	100				
Research & Design 3.0.2	**Mean**	43.48	82.83	39.35	13.95	6.03E-18	2.06
	Std. Deviation	16.63	14.25	46.00			
	N	46	46				
	Max Points Possible	100	100				
Robots 3.2.3	**Mean**	NA	NA	NA	NA	NA	NA
	Std. Deviation	NA	NA	NA			
	N	2	2				

	Max Points Possible	100	100				
Rocketry & Space 3.0.2	**Mean**	55.20	77.60	22.40	6.06	1.91E-07	0.86
	Std. Deviation	22.52	22.18	50.00			
	N	50	50				
	Max Points Possible	100	100				
Simple Machines 3.0.1	**Mean**	40.77	56.92	16.15	2.58	0.0240	0.72
	Std. Deviation	19.77	20.97	13.00			
	N	13	13				
	Max Points Possible	100	100				
Sustainable Agriculture 3.0.2	**Mean**	36.25	53.75	17.50	3.59	0.0027	0.90
	Std. Deviation	19.62	22.17	16.00			
	N	16	16				
	Max Points Possible	100	100				
Video Production 3.5.2	**Mean**	33.33	40.00	6.67	0.76	0.5286	0.44
	Std. Deviation	5.77	17.32	3.00			
	N	3	3				
	Max Points Possible	100	100				

Table 50. Detailed product assessment data

Qualitative Assessment

Table 51 below shows the results of the "student perceptions" survey. This survey asked students to describe their ability to think critically about their class, decide what and how they learned, and the amount of interaction they had with their peers. On a Likert scale from "almost never” to “almost always,” students had a notable lack of variation in their responses. Students answered positively to the majority of prompts. Rather than negative responses, those that were not clearly positive, had nearly equal rates of response for each of the 5 scale items, with the exception of the prompt, “students get to choose activities.” This elicited mostly negative responses. Otherwise, it appears that students had a fair amount of freedom to collaboratively explore the curriculum, openly criticize what they did not like, admit when they needed help, and self asses their progress.

Students also noted that they learned about STEM in the outside world and its applicability to multiple disciplines. From these students’ perspective, the CTE curriculum they experienced provided opportunities to develop 21st century skills, and to explore future studies and careers in STEM fields.

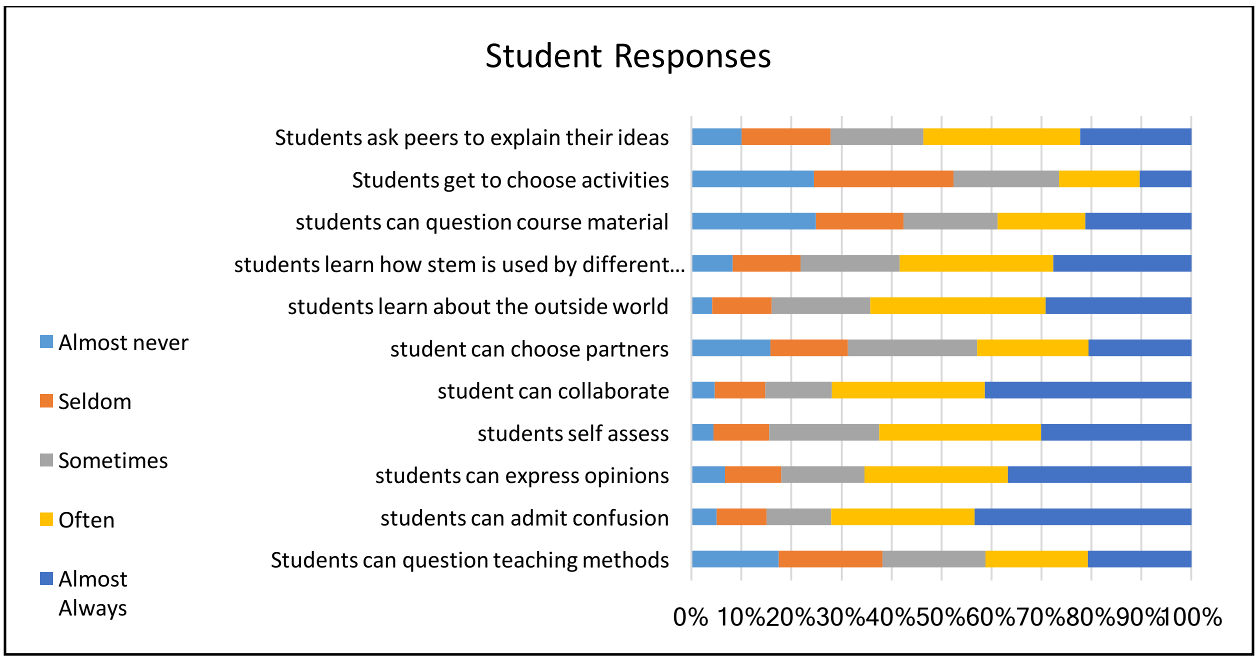


Figure 51. Student survey responses

At the end of the academic year, students were asked to give a STEM career that they found interesting. There were a little more than 100 unique STEM careers listed, many were very specific (e.g., bio-medical engineer, archeologist, botanist, electrical engineer, etc.). Only 75 students out of approximately 2300 respondents stated that they were not interested in any STEM careers. There were 243 who did not know a STEM career in which they would be interested. Table 51 summarizes the various STEM careers students listed. Architect was included as its own category because so many students listed this career.

Engineer	Science Related	Medical Related	Computer Related	Traditional Trades	Art related	Architecht	Don't want a STEM Career	Don't Know
523	174	248	255	205	103	173	75	243

Table 51. Summary of STEM careers in which students showed interest

As can be seen in Table 52, the teacher responses to classroom environment have even less variation than the student responses. The only prompt with a significant number of negative responses asked teachers to assess their student's ability to be self-directed. The remaining prompts asked about the atmosphere the teacher creates in their classroom. Perhaps unsurprisingly, teachers overwhelmingly responded that they create an open and exploratory environment for their CTE students. This agrees with students' survey responses.

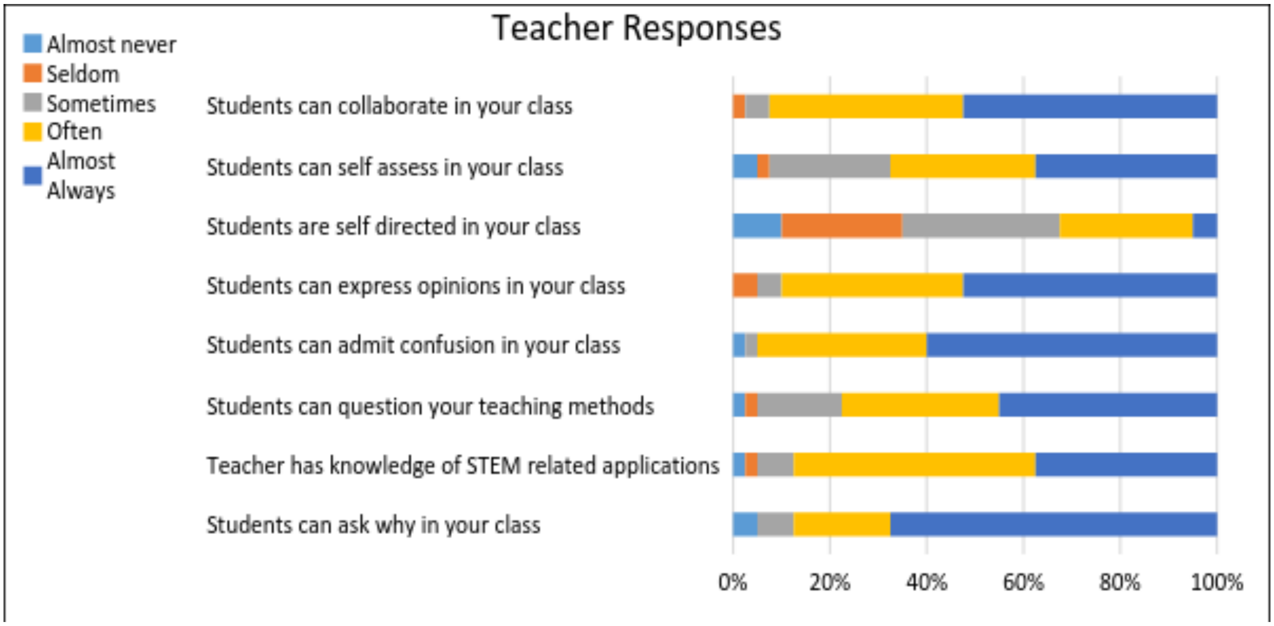


Figure 52. Teacher survey responses

Teachers were also asked about their satisfaction with the CTE product chosen by their school district, its effect on student engagement, and its accompanying professional development (PD). Interestingly, while teachers seemed to like the product and the provided PD, they were less inclined to recommend the product to their peers. The responses related to recommending the product were clustered toward the center of the Likert scale, with exactly the same number of responses for very unlikely, somewhat likely, and very likely, giving product recommendation a proverbial grade of C. Teacher's free responses regarding satisfaction with PD, satisfaction with the product, observations with engagement, and product recommendation that were categorized in Tables 53-56. Teachers generally indicated they liked the product, but desired more PD.

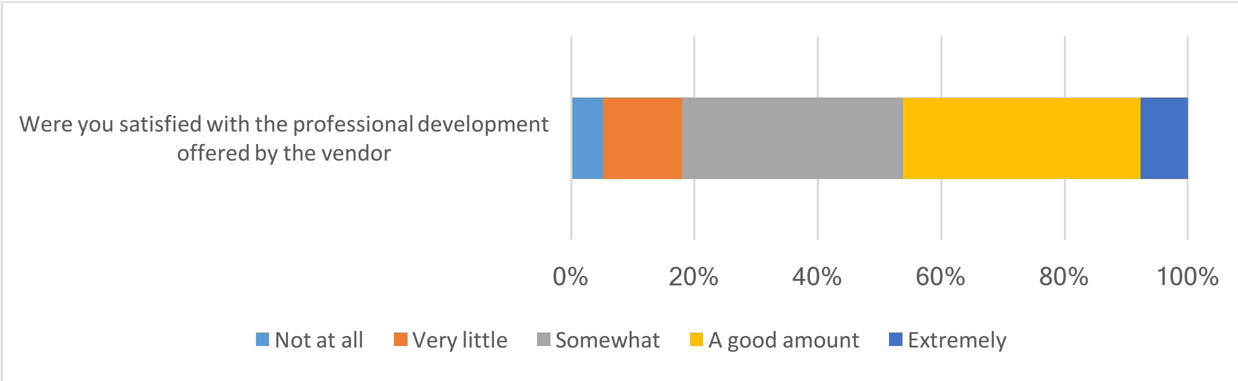


Figure 53. Teacher survey responses regarding CTE product professional development.

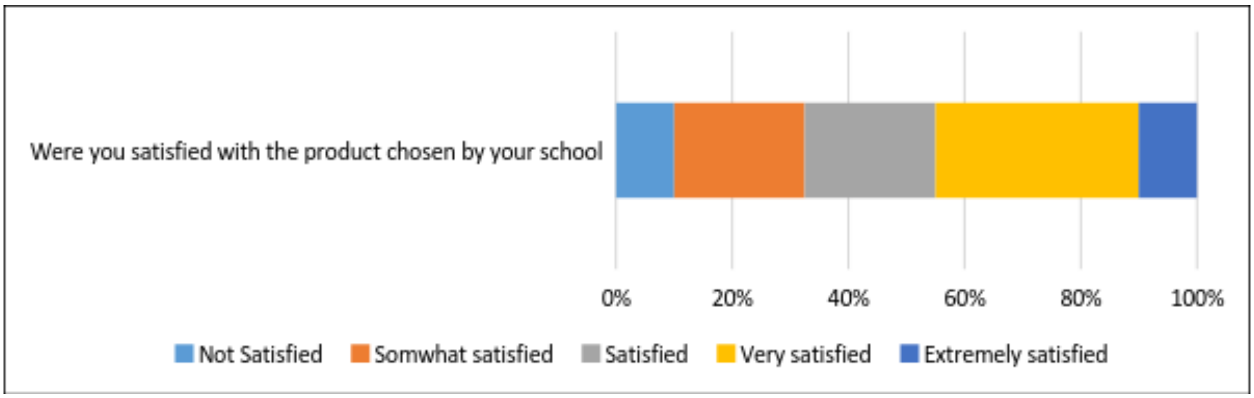


Figure 54. Teacher survey responses regarding product satisfaction.

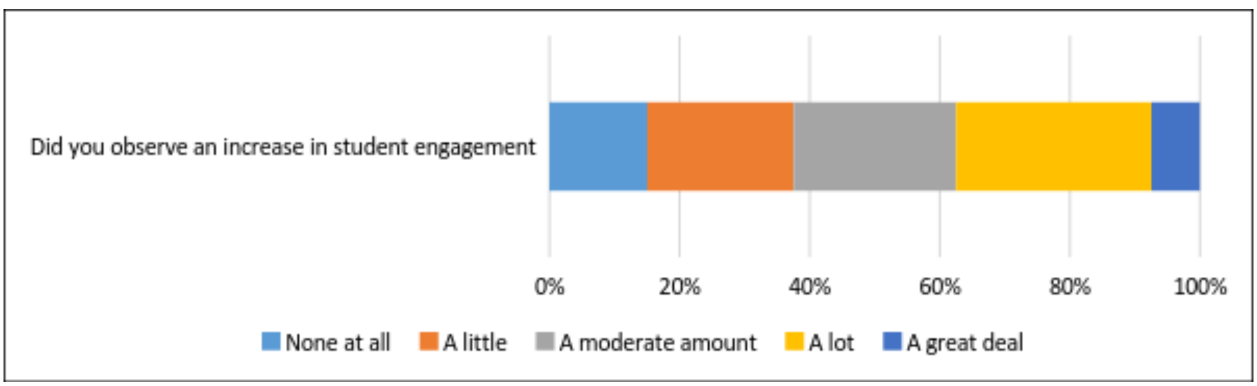


Figure 55. Teacher survey responses regarding student engagement.

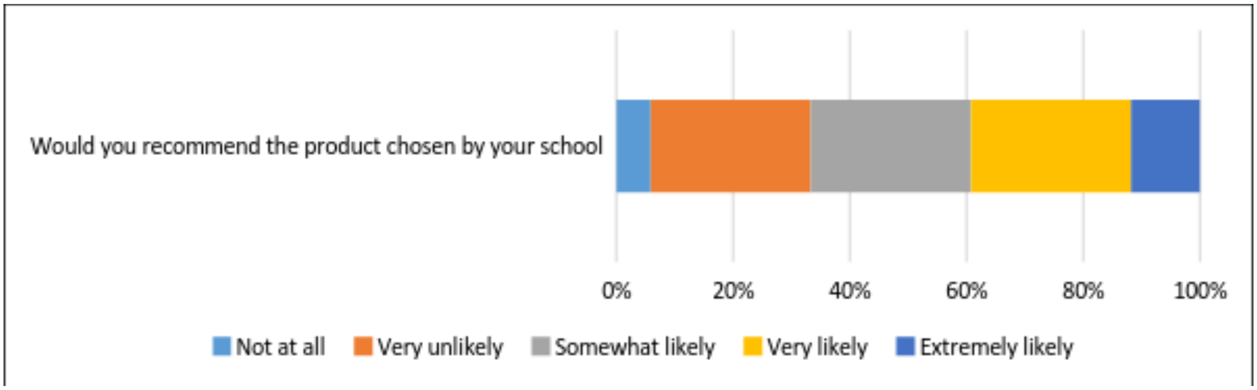


Figure 56. Teacher survey responses regarding product recommendation.

In Table 53, the free response questions from the "teacher perceptions" survey are categorized by theme. Overall, 81.8% of individuals said they would like to continue using the same product. However, the number of responses to the teacher survey was somewhat low, a total of 41. Thus, caution should be taken when drawing conclusions from this survey. Those who responded also noted that the products increased students' engagement, with one teacher saying "they are very eager to learn from [the lessons] and they have behavior that keeps them focused and engaged." Teachers also noted that the products increased students' STEM skills and knowledge.

While students reported greater collaboration with their peers, teacher collaboration was mixed, with nearly a 50-50 split between teachers who said they had the same level of collaboration during the implementation and those who said they had greater collaboration. Nearly 27% of participating teachers made positive comments about the CTE product their district chose. These comments tended to be specific toward the wide array of lesson material and diversity, with one teacher stating that "I am pleased with the amount of information available to offer the students. I don't feel like I need to scramble to find materials or assessments."

Finally, most teachers noted that they liked the PD offered by the vendors, but would have liked to dive deeper into the curriculum. In particular, they wanted to both learn more about the curriculum and troubleshoot prior to taking it live into the classroom. For example, one teacher noted that, "I would like to spend time going through the modules, working out the bugs, and learning from others in the same situation." Because PD appeared to be critical to the successful implementation of these products, we give a more detailed description of the issues regarding PD in what follows.

Product Comments

Positive Categories	N	Frequency	Representative Example
Robust curriculum	46	26.44%	I am pleased with the amount of information available to offer the students. I don't feel like I need to scramble to find materials or assessments.
Generally good	19	10.92%	It had a good general idea.
Good product support	9	5.17%	Tech support is wonderful.
Excited about materials/content	7	4.02%	I have robotics.
Hands on	5	2.87%	The kids love being engaged in a hands on project.

Negative Categories	N	Frequency	Representative Example
Anemic/disconnected curriculum	25	14.37%	The structure and clarity of the lesson plans is at best confusing and sometimes incomprehensible. On several lessons I felt like I had to figure out what I was supposed to rather than having a clear lesson plan already prepared.
Excessive prep	18	10.34%	So far this year I have donated approximately 200 hours that have not been compensated. Not all teachers are willing to do this, and the ones that don't will only have limited success with this program.
Technical problems	17	9.77%	Sometime there are problems finding supplies. Technical glitches on computers. One piece of

			equipment did not work, but Pitsco had it replaced within days.
Unrealistic timeframes for implementation	15	8.62%	If I were to follow the expected pacing, as some teachers have, the students would be frustrated, ultimately bored, and feel as if they just can't finish any projects!
Shoddy product	7	4.02%	Most mobile labs aren't built to last through several groups of students. We received the lab from another school and several of the pieces were not working and needed replacement.
General negative product comments	4	2.30%	The activities are not bad, some are not very realistic as to implementing in classes with real kids. The lesson plans are not very good.
Poor product support	2	1.15%	the customer service is non-existent.

Table 52. Teacher survey responses regarding product satisfaction.

Professional Development

Positive Categories	N	Frequency	Representative Example
general positive PD comments	18	16.51%	The PD was great because it introduced the content of the lessons. I have had any support I needed since implementation.
Continued provider support	9	8.26%	The tech support folks always make sure that my concerns are addressed. They never "drop the ball".
Good start-up training	8	7.34%	Great start up training.
Interactive/hand-on PD	8	7.34%	very hands on. Taught us just like we were going to teach our students. Instructors always willing to answer questions.
Training provided by district/colleagues	3	2.75%	Other teachers explaining how they use it in their class.

Negative Categories	N	Frequency	Representative Example
More/Targeted PD	60	55.05%	I would like to spend time going through the modules, working out the bugs, and learning from others in the same situation.
Unfriendly PD staff	1	0.92%	I was not satisfied with the teachers they were cruel and made us work hard assignments
Excessive personal time for PD	1	0.92%	I would prefer that any more professional development is during contract hours
Direct instruction	1	0.92%	Direct instruction and teaching of the product.

Table 53. Teacher survey responses regarding product professional development.

Teacher Collaboration

Positive Categories	N	Frequency	Representative Example
Increased collaboration	29	43.94%	I have enjoyed getting together for several professional development days throughout the school year as we've learned together how to use this CTE product.
Desires greater collaboration	1	1.52%	I wish we had more collaboration time or virtual time to discuss how things can get better as we become more familiar with teaching with the STEM Academy supplies.

Negative Categories	N	Frequency	Representative Example
Status quo collaboration	32	48.48%	no change
No time	3	4.55%	None... I have spent my time organizing the animal.
Not aware of other users	1	1.52%	I am not aware of the other STEM teachers using this.

Table 54. Teacher survey responses regarding teacher collaboration.

Teacher Perceptions of Student Reactions

Positive Categories	N	Frequency	Representative Example
Increased motivation	19	31.67%	they are very eager to learn from them and they have behavior that keeps them focused and engaged
Increased knowledge	12	20.00%	I think it went well. The students were engaged and they learned skills that can help them make career choices that they are interested in.
Increased skills	8	13.33%	They have been able to increase their confidence in what they can achieve through the hands on activities.
Generally well received	6	10.00%	Students enjoyed the activities.
Increased student collaboration	1	1.67%	helped them learn to work together,

Negative Categories	N	Frequency	Representative Example
No change in student motivation	4	6.67%	very little for the most part. There are only a handful of students that are really excited about certain programs
Course is for more "academic" students	4	6.67%	I think that those that applied themselves and used to stations as they were intended had a great experience and learned a lot. For some it was a waste of time.
Students were unenthusiastic	3	5.00%	I feel like this product does not allow them to develop their skill with the machines, which is a shame because it broke down barriers; kids (especially girls) who were never interested in working with machines would go home loving the projects they made with the machines and they were not afraid of them anymore
Unknown	3	5.00%	Yet to be determined

Table 55. Teacher survey responses regarding students' reactions to the CTE curriculum.

Ongoing Use

Positive Categories	N	Frequency	Representative Example
Continued use	27	81.82%	Continue to use the program if possible
Negative Categories			
Continued use, but not by choice	4	12.12%	I don't have a choice, except to use this and modify the best I can.
Thinks unavailable for future use	1	3.03%	I suppose it will go on to the next school. We are on a rotation and won't have it all the time because it is a mobile lab.
Prefers not to continue with same product	1	3.03%	I have no idea what the school district is going to do. I would very much like to change things dramatically if that is possible.

Table 56. Teacher survey responses regarding ongoing product use.

Professional Development

The dearth of professional development (PD) was an area of concern for most teachers participating in the CTE grant program. Though each vendor provided PD that was highly regarded by many teachers, it was insufficient in scope and frequency for such a broad new curriculum. Given that "teachers are the key agents when it comes to changing classroom practices (Spillane, 1999)," special attention should be given to barriers effecting teacher's ability to implement any curriculum. Anemic professional development is one such barrier.

Contemporary CTE curriculum diverges from prototypical "shop" skills like carpentry, welding, etc., introducing students to cutting edge areas like computer science, robotics, and engineering. The combination of these disciplines makes CTE the ultimate multi-disciplinary classroom, thus teachers must be adroit in a number of discrete disciplines if they hope to share the intuition necessary for students to be successful within their program. As Mukembo and Edwards (2015) noted, however, modern classrooms still suffer from the siloed learning model. This implies that the distance between teachers' "zone[s] of enactment" (Spillane, 1999), or the space in which they put theory into practice, and the new curriculum may be too great to bridge effectively without comprehensive PD. The one off PD that has been seen in Mukembo and Edwards (2015), Stachler, Young, and Borr (2013), Christou et al. (2004), and in the present study, leaves teachers feeling frustrated at the amount of personal time necessary to fill the gap, assuming they are willing to take this time to teach themselves the pre-requisites necessary to teach this new curriculum. Rather than rely on teachers' altruism, research suggests that PD that is frequent, coherent, engaging, and encourages teachers to collaborate with their peers and those from different disciplines should be developed and implemented. If this is enacted, more teachers will have the efficacy necessary to increase student success in modern Career and Technical Education.

In the present study, teachers' challenges related to PD more or less mirrored those in Mukembo and Edwards and Christou et al. (2015), with the exception that some vendors provided a week long summer PD rather than two or fewer days. The evidence of this is seen in the "Teachers' Perceptions" survey instrument, where 55% of comments related to PD were requests for more targeted, or in depth, PD at greater frequency. Teachers specifically called for PD that allows them time to work through entire units in collaborative groups. As one teacher noted, “I would like to spend time going through the modules, working out the bugs, and learning from others in the same situation.”

PD that matches these teachers’ requests may have reduced the number of teachers who stated that the curriculum was anemic or disconnected. With the exception of the 7th grade CTE courses, there was no evidence to suggest that teachers’ complaints in this area was anything but a lack of experience with a very different curriculum than that of previous years. In fact, many teachers noted the excessive preparation time needed to learn the new material before presenting it to students. Those who spent extra prep time, tended to regard the product their district adopted more positively, and viewed student outcomes more positively.

The 7th grade CTE course was a special case, since the Utah State Board of Education (USBE) implemented a new curriculum of its own at the same time that these four new CTE products were being rolled out. The USBE mandated curriculum, called “College and Career Awareness” (CCA), frustrated many teachers by imposing timelines that teachers felt were unrealistic. For example, one teacher noted that “I went deeper than the USBE asked (or even allowed), which truly made the time valuable. If I were to follow the USBE pacing, as some teachers have, the students would be frustrated, ultimately bored, and feel as if they just can't finish any projects!” We looked at the CCA lesson plan, “Information Technology: how a coder does it,” and noticed that the lesson plan was estimated at 50 minutes, but included an “hour of code” from Code.org as a major part of the lesson plan.

Teachers’ survey responses clearly show that organizational issues intensified the need for expanded and coherent PD, especially for the 7th grade products. Given the research in this evaluation study, expanded PD is a good option for removing barriers during the implementation of a new curriculum.

Other Issues

Beyond the scope of this paper, but of interest, are the "buzzword" names that are given to the College and Career Readiness lessons providing students with misconceptions about developing career opportunities. For example, a lesson called, "Information Technology: Big Data," suggested that students complete some basic statistical analysis, when in fact, big data does not generally yield to traditional statistical methods due to the extraordinary number of data points included in such a set of data. If students are to maintain an increased interest in STEM fields, they must have a clear picture of what these look like.

Finally, technical problems teachers faced during the implementation of the CTE curriculum were a barrier for successful implementation. STEM Academy did not give some teachers functional student access codes for their online content until half way through the academic year. In contrast, most comments related to technical problems positively mentioned the other three vendors' quick response and solutions. Nevertheless, this may have detracted from students' experience because replacement parts or products needed to be shipped.

We divided comments related to technical problems into two categories. First, "technical problems," which are general in nature and not recurring. For example, some teachers had some computer glitches, but the vendor fixed them immediately and the teacher did not note any further difficulties. Second, "shoddy product," which refers to recurring problems with a specific product. For example, many teachers mentioned the 3-D printers specifically. It appears that a consumer version, rather than an industrial version, of a 3-D printer was provided to schools by the vendor. In general, teachers noted that the vendors were excellent at handling technical problems, however, one technical problem early in the day can cause a teacher to lose an entire day of planned instruction, and if the problem persists, the teacher may have to alter course completely.

Discussion and Recommendations

Overall, teachers stated that they were pleased with the CTE curriculum chosen by their local education agency (LEA), noting that it provided students with a classroom fostering 21st century curricular ideals. In particular, teachers' survey responses described a classroom where students were free to question what and how they learned, enjoyed greater collaboration, and could assess their own learning. In addition, teachers noted that the curriculum increased students' STEM skills and knowledge through a diverse set of activities.

Teachers noted, with some major limitations, that the vendor provided professional development was excellent. However, one of these limitations caused teachers to spend excessive personal time learning and preparing to teach a far broader curriculum than has been taught previously. Research recommends (Asunda, Finnell, & Berry, 2015; Christou, Eliophotou-Menon, & Philippou, 2004; Kleickmann, et al., 2013; Mukembo & Edwards, 2015; Spillane, 1999; Stachler, Young, & Borr, 2013) that future implementations of similar curriculum provide PD that delves deeper, is more collaborative, and more frequent over a longer period of time than that seen in this implementation. Following this recommendation may increase student achievement through improved instruction.

While, on average, students had statistically significant achievement gains on a majority of vendor provided assessments, no data was provided regarding their validity. In addition, data quality issues prevented the collection of students' SAGE scores. Among other issues, data showing the levels of use for each of the four CTE products was not available, nor may it be in future implementations. The nature of CTE curriculum precludes computer use, which is the only feasible measure of product usage under the constraints of this study. Therefore, it is recommended that future implementations include an expanded set of vendor provided assessments, under the condition that these assessments have been vetted for reliability, and are relevant to student learning levels and objectives. In addition, it is recommended that any new assessments be specifically aligned with the Utah CTE core curriculum.

This evaluation study showed that the implementation of four new CTE curricula throughout the state of Utah had positive impacts on students' and teachers' perceptions of these products. If future implementations of such products have improved PD, data quality, and assessment practices, then future evaluations may study outcomes related to student achievement.

References

AERA. (2014). *Standards for Educational and Psychological Testing.* Washington DC: American Educational Research Association.

Asunda, P. A., Finnell, A. M., & Berry, N. R. (2015). Integration of the Common Core State Standards into CTE: Challenges and Strategies of Career and Technical Teachers. *Career and Technical Education Research, 40*(1), 49-62.

Brasiel, S., & Martin, T. (2015). *STEM Action Center Grant Program Annual Evaluation Report.* Logan: Utah State University, Department of Instructional Technology and Learning Sciences.

Cangelosi, J. S. (2000). *Assessment strategies for monitoring student acheivment.* New York: Longman.

Cangelosi, J. S. (2003). Assessing and Reporting Students' Progress with Mathematics. In J. S. Cangelosi, *Teaching Mathematics in Secondary and Middle School: An Interactive Approach* (pp. 300-304). Upper Saddle River, NJ: Pearson Education Inc.

Christou, C., Eliophotou-Menon, M., & Philippou, G. (2004). Teachers' Concerns Regarding the Adoption of a New Mathematics Curriculum: An Application of CBAM. *Educational Studies in Mathematics, 57*, 157-176.

ITEEA. (2016, August Monday). *ITEEA STEM Center*. Retrieved from ITEEA: https://www.iteea.org/Ebd.aspx

Kleickmann, T., Richter, D., Kunter, M., Elsner, J., Besser, M., Krauss, S., & Baumert, J. (2013). Teachers' Content Knowledge and Pedegogical Content Knowledge: The Role of Structural Differences in Teacher Education. *Journal of Teacher Education, 64*(1), 90-106.

Mukembo, S. C., & Edwards, C. M. (2015). Long-term Impacts of Professional Development on Teachers Using a Math-enhanced Curriculum in Agriculture Power and Technology: A 10-year Retrospect. *Career and Technical Education Research, 40*(3), 174-190.

National Education Association. (2016, August 4). *NEA: Statement of principles: 21st century skill and the reauthorization of NCLB/ESEA*. Retrieved from NEA: http://www.nea.org/home/17154.htm

Pitsco, Inc. (2016, August 8). *Pitsco*. Retrieved from Pitsco: About: http://www.pitsco.com/about/

Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of curriculum Studies, 31*(2), 143-175.

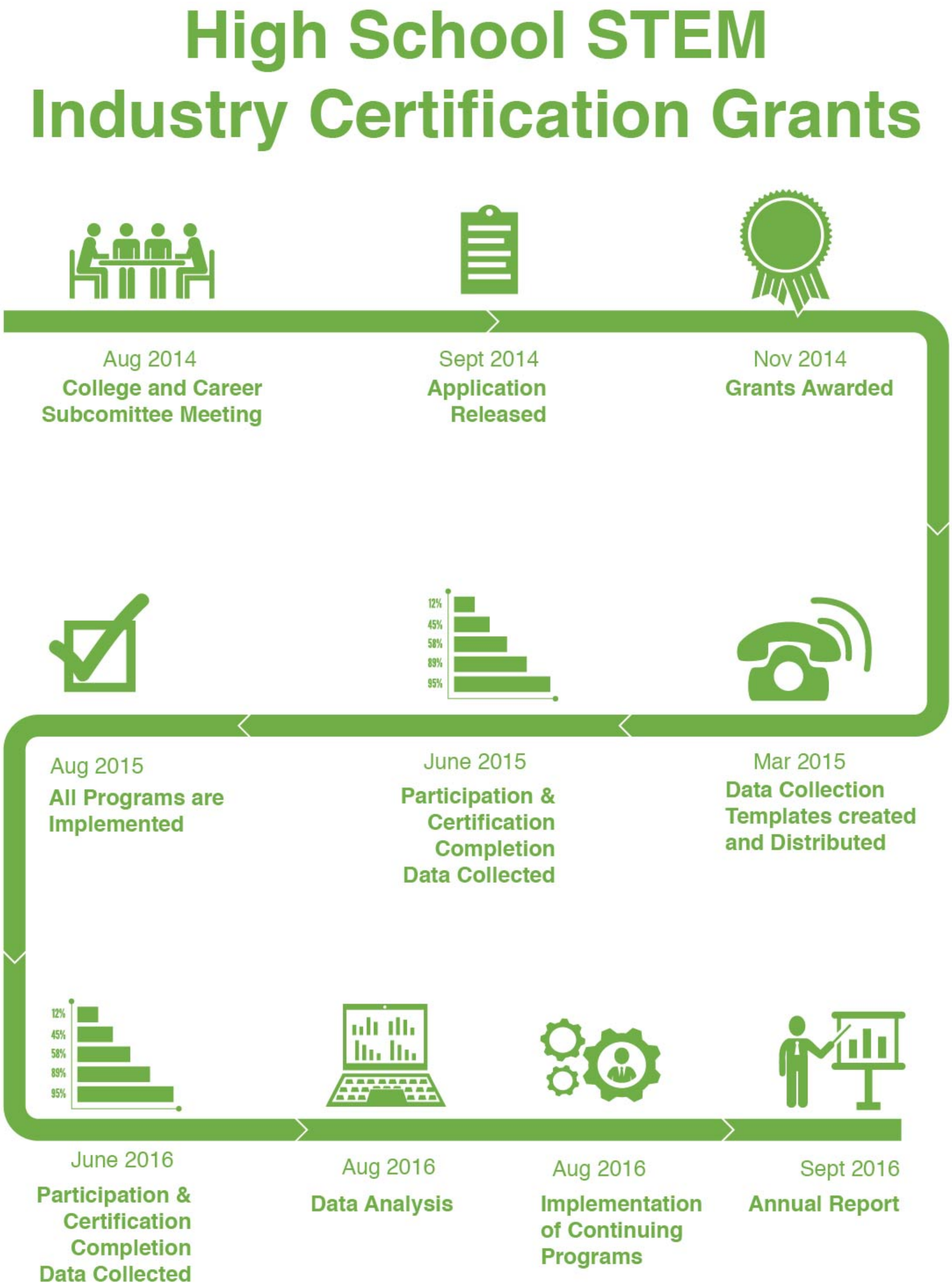
Stachler, W. M., Young, B. R., & Borr, M. (2013). Sustainability of professional development to enhance student achievement: A shift in the professional development paradigm. *Journal of Agricultural Education, 54*(4), 13-30.

STEM 101. (2016, August 1). *STEM 101: Middle Grades*. Retrieved from STEM 101: https://stem101.org/our_programs/

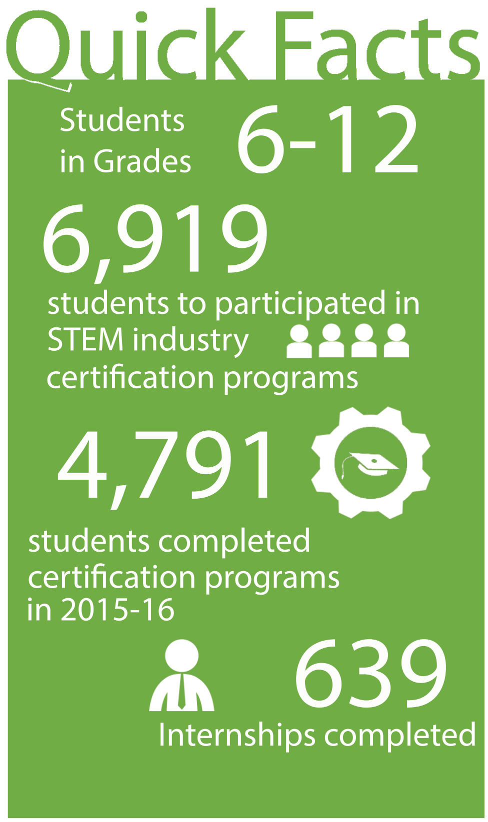
The Partnership for 21st Century Learning. (2016, August 2). *Framework for 21st Century Learning.* Retrieved from P21: http://www.p21.org/about-us/p21-framework

UEN. (2016, August 1). *Utah Education Network: Utah Core Standards*. Retrieved from UEN: www.uen.org/core/

Chapter 5 - High School STEM Industry Certification Program Grants



Introduction



The High School Industry Certification grant program began with a College and Career Subcommittee meeting in August 2014 to determine important considerations to include in the request for applications. The STEM Action Center released the application information in September 2014, and they gave districts time to develop partnerships with universities, applied technology colleges, and local industry partners. The STEM Action Center awarded grants beginning in November 2014.

The Utah Department of Workforce Services projects there will be over 100,000 new jobs in STEM industries by 2022. Many STEM industries are also among the fastest growing industries in the state (Utah Department of Workforce Services, 2014). There appears to be a great need for students certified in STEM fields. Research shows that students that devote one-sixth of their time in high school to vocational courses earn 12% more one year after graduation and 8% more seven years after graduation than those who do not (Bishop & Mane, 2004). Research has also found that work-based learning tends to result in increased retention of knowledge, deeper understanding of subject matter, and the ability to apply knowledge and skills in ill-structured environments (Lynch, 2000). Many of the STEM industry certifications provided in these programs are CTE courses. Researchers have found that 60% of students that concentrate on CTE courses in high school seek high education at either an applied technology college or a traditional university (Gray, 2004).

There have been twelve High School Industry Certification grants awarded. From 2014-2016, these programs have involved 17 LEAs, 14 universities and technical colleges, 44 industry partners, and over 6,900 students. The program has resulted in over 4,700 certifications and 600 internships. Two programs, AM STEM and Summit Academy STEM IT, concluded in Spring of 2015. AM STEM reported 15 participants earning 44 certifications, and 11 internships. STEM IT reported 66 participants earning 2 certifications, and 66 internships. For more information on these two programs see last year's report (Brasiel & Martin, 2015). An overview of each ongoing program follows:

Automated Manufacturing and Robotics STEM Academy

The Automated Manufacturing and Robotics program was administered to students through the Bear River Region High Schools. This grant was used to develop a STEM academy implemented via a combination of broadcast and in person courses. This allowed early morning lab classes to be broadcast to 6 high schools and 2 technical college campuses. These early morning lab classes have been approved for credit at Bridgerland Applied Technology College (BATC) in their industry recognized Automated Manufacturing and Robotics STEM certificate. Students also receive credit through Utah State University's (USU) Associate of Technology AAS Degree. Upon completion of the AAS degree students can continue to earn a STEM degree at USU or Utah Valley University (UVU).

This STEM Academy has been supported by the following industry partners, all of which employ Robotics Technicians:

- Autoliv
- MOM Brands

- Icon Health and Fitness
- Schreiber Foods Inc.
- ATK
- ASI

This grant included students from the following school districts:

- Cache County School District
- Box Elder School District
- Rich County School District

The STEM Academy received a $600,000 grant to be used to:

- Build and equip distance education sites
- Purchase lab equipment including training robots, computers, and software
- Curriculum development and teacher training
- Marketing and promotion

(Bear River Region High Schools, 2014)

Corporate Connections in Manufacturing

The Corporate Connections in Manufacturing program was administered to students through the Southeast Region Consortium. This grant was proposed to develop 10^{th}-12^{th} grade elective courses that students could take in order to obtain a Utah Manufacturing Certified Associate Certificate, which is recognized by local manufacturing companies. The courses could also be applicable for credit towards a bachelor's degree at Utah State University-Eastern. At the end of each course, students would complete a culminating project sponsored by a local company in which the certified skills will be demonstrated.

The development of the Utah Manufacturing Certified Associate Certificate Curriculum was supported by:

- The Utah Manufacturers Association (UMA), an association of nearly 1,000 manufacturing companies throughout the state of Utah.

This grant included teachers from the following school districts:

- Carbon School District
- Emery County School District
- San Juan School District
- Grand County School District

The Southeast Region Consortium received a $375,000 grant to be used for:

- Project development
- Development of online exchange
- Creation of dual credit relationships
- Teacher training

(Southeast Region Consortium, 2014)

The Davis/Morgan Region UCAT STEM Certification Enhancement Program

The Davis/Morgan Region UCAT STEM Certification Enhancement Program was administered to teachers and students through the Davis and Morgan County School Districts. This grant was used to allow teachers to attend Davis Applied Technology College (DATC). Courses were used as professional development to better inform teachers of the current offerings at DATC. Teachers then received equipment for which they had been trained during the courses in order to better inform their students of the Utah College of Applied Technology (UCAT) certification programs offered at the DATC. Students in the Morgan and Davis County School Districts are given the chance to concurrently enroll in UCAT certification programs at DATC tuition free while attending high school (About DATC, 2016). This program was to raise awareness of and increase enrollment in UCAT Programs at DATC. This program will also provide $1,000 scholarships to 50 students to complete certification programs at DATC after graduation.

The UCAT STEM Certification Enhancement Program was supported by the following industry partners:

- ATK
- Holcim

The grant included students and teachers from the following school districts:

- Davis County School District
- Morgan County School District

The Davis/Morgan Region UCAT STEM Certification Enhancement Program received a $358,017 grant that was used for:

- Classroom instruction coverage, if the course in which a teacher was enrolled occurred during teacher contract time.
- Stipends if the course in which a teacher was enrolled occurred on a Saturday
- DATC tuition
- Equipment
- Student DATC scholarships

(Davis and Morgan County School Districts, 2014)

The Life Science Certification Project

The Life Science Certification Project was administered to students through the Granite School District. This grant was used to develop curriculum in order to enhance current training being provided by the Granite School District BioInnovations and Biomanufacturing programs. This new curriculum was developed with the help of industry partners, through the Granite Biotechnology Advisory Board, to provide students with the training necessary to obtain entry level employment. The new curriculum was also designed to align with courses taught at Salt Lake Community College (SLCC) so that students may earn concurrent credit towards a certification or degree. Upon completion of course work students will seek industry internships through the assistance of the BioInnovations Gateway.

The Life Science Certification Project was supported by the Granite Biotechnology Advisory Board which includes the following industry partners:

- Amedica Corp.
- ARUP Laboratories
- BioFire Diagnostics, Inc.
- Echelon Biosciences Inc.
- Edwards
- 4 Life Research
- Fresenius
- Genysis Nutritional Labs
- GOED
- IHC
- LRS Consulting
- Merit Medical Systems
- Scientific Computing &Imaging (SCI) Institute
- Nelson Laboratories
- NUVO Research
- Sorensen Genomics
- Wasatch Innovations
- Utah Valley University
- Salt Lake Community College

The grant included students from Granite School District. The Life Science Certification Project received a $280,397 grant to be used for:

- Salaries for Lab Assistants
- Software
- Marketing
- Professional Development
- Equipment

(Granite School District, 2014)

Pathways to the Future in Advanced Manufacturing

The Pathways to the Future in Advanced Manufacturing was administered to students through Wasatch Front South Region school districts. This grant was used to design and implement clear pathways for entering into manufacturing careers through the identification or development of industry recognized certification. The Wasatch Front South Region school districts worked closely with Utah Manufacturers Association (UMA) and Salt Lake Community College (SLCC) to modify existing courses to provide concurrent enrollment towards SLCC certifications and degrees, as well as provide students with an industry recognized certification for their course work in high school. When students have earned the industry recognized certification they will be eligible for internships and entry level employment in the manufacturing industry.

The development of the modified curriculum was supported by:

- The Utah Manufacturers Association (UMA), an association of nearly 1,000 manufacturing companies throughout the state of Utah.

The grant included students from the following school districts:

- Granite School District
- Canyons School District
- Jordan School District
- Murray School District
- Salt Lake City School District
- Tooele School District

The Pathways to the Future in Advanced Manufacturing received a $500,000 grant used for:

- Professional Development
- Marketing
- Updating Equipment
- Pathway & Curriculum Development

(Wasatch Front South Region Districts, 2014)

Nebo Advanced Learning Center

The Nebo Advanced Learning Center was administered to students through the Nebo School District. The grant was used to expand the curriculum of the recently established Nebo Advanced Learning Center. The advanced learning center had previously facilitated a construction/manufacturing program; this grant has funded the development of five additional programs. The new programs are: IT, Computer Science and Software Development, Digital Media, Bio-Medical Science, and Pre-Engineering. The new programs were developed with Mountainland Applied Technology College (MATC), Utah Valley University (UVU), and

Weber State University (WSU) to provide concurrent credit to students. Nebo School District also sought input from industry partners to provide recognized certificates of proficiency.

The development of the new programs was supported by:

- IHC
- MountainStar Health
- US Synthetics
- Jive Communications
- BYU Engineering Department

The grant included student from Nebo School District. The Nebo Advanced Learning Center received a $300,000 grant used for:

- Professional Development
- Curriculum Development
- Equipment
- Administrative Staff

(Nebo School District, 2014)

SOAR into STEM

Students in Ogden Achieving Readiness into Science, Technology, Engineering, and Mathematics (SOAR into STEM) was administered to students through the Ogden City School District. This grant was used to develop and expand STEM-related pathways in Ogden City School District. The district created an Advanced Composites certificate pathway and expanded the current Information Technology and Software, and Engineering pathways. These pathways are being developed with input from Ogden-Weber Applied Technology College (OWATC) and Weber State University (WSU) in order to facilitate recruitment, enrollment, and retention in post-secondary STEM programs. Local industry partners were also consulted in curriculum development in order to develop industry recognized certificate programs.

The development of the pathway curriculum was supported by:

- Hill Air Force Base
- Northrop Grumman
- Purch
- Parker Hannifin
- LSI
- Williams International
- L3 Communications

This grant served students in the Ogden City School District. SOAR into STEM received a $339,958 grant that was used for:

- Curriculum Development
- Professional Development
- Marketing
- Performance Incentives

(Ogden City School District, 2014)

3C^5 Consortium

The 3C^5 Consortium was administered to students through Washington County School District, Iron County School District and SUCCESS Academy. The grant was used to design and implement Computer Science curriculum, leading to an industry recognized certification, at schools in Washington County School District, Iron County School District, as well as the two SUCCESS Academy campuses. Curriculum was developed in collaboration with Dixie Applied Technology College (DXATC) and Southwest Applied Technology College (SWATC). The curriculum was designed to lead to an optional bachelor’s degree in Computer Science or to lead to an industry recognized certification. The Consortium has also worked with local companies to provide internships for students who complete the certification.

The development of the new curriculum was supported by:

- Busybusy
- ROCKETMADE
- SyberJet
- Southwest Educational Development Center

This grant served students in:

- Washington County School District
- Iron County School District
- DSU SUCCESS Academy
- SUU SUCCESS Academy

The 3C[5] Consortium received a $401,492 grant used for:

- Internship Coordination
- Marketing
- Curriculum Development
- Professional Development
- Equipment

(3C5 Consortium, 2014)

Phase One of Tooele County School District and Tooele Applied Technology College Alignment Project

The Phase One of Tooele County School District (TCSD) and Tooele Applied Technology College (TATC) Alignment Project was administered to students through Tooele County School District. This grant was used to develop concurrent enrollment curriculum for Welding/Manufacturing and Information Technology. TCSD and TATC also worked to increase enrollment in the new aligned courses when compared to the enrollment in the previous courses.

The new aligned curriculum was supported by:

- Carlisle SynTec
- Tooele County Alliance
- Cargill

The grant served students from Tooele County School District. The Alignment project received a $339,123 grant used for:

- Curriculum Development

- Supplies
- Equipment

(Tooele County School District, 2014)

STEM Series

STEM Series was administered to students through Washington County School District. This grant was used to develop a certification program requested by local industry partners to create a pool of qualified interns. The program was developed in collaboration with Dixie State University (DSU) and Dixie Applied Technology College (DXATC). The certification program will not qualify most students for entry level employment and therefore a concurrent enrollment program is necessary.

The program development was supported by:

- Rocketmade
- Velocity Webworks
- Busy Busy
- Y Draw Inc.
- USTAR

The grant served students in Washington County School District. STEM Series received a $121,125 grant used for:

- Curriculum Development
- Equipment

(Washington County School District, 2014)

Methods

Each grant recipient was asked to track enrollment and completion data including program name, district name, high school name, certification school name, student name, certification name, certification completion status, internship name, and internship completion status. Data was then sent to the evaluation team through a secure portal. Participating teachers and students were provided a voluntary survey in December which was used to collect anecdotal recommendations.

Once data was collected, a quantitative frequency analysis was conducted. The summarized results were translated into graphs and other statistical visualizations, which were synthesized into this annual evaluation report for the STEM Action Center. PowerPoint Presentations summarizing the findings have also been created to be presented to the STEM Action Center board of directors and the Utah State legislature.

Results

The STEM Action Center awarded 12 partnership organizations with High School STEM Industry Certification grants with a total of $3,882,962 awarded. These programs served students in grades 6 to 12. These grants made STEM Industry Certifications available to at least 115,178 students in 17 LEAs (USBE, 2015). As of August 2016, 6,919 students have participated in these programs resulting in 4,791 certifications and 639 internships. Currently, 5.96% of students in participating LEAs are enrolled in a High School STEM Industry Certification grant program. A graphical summary of enrollment, certifications and internships follow (STEM Action Center, 2014-2016).

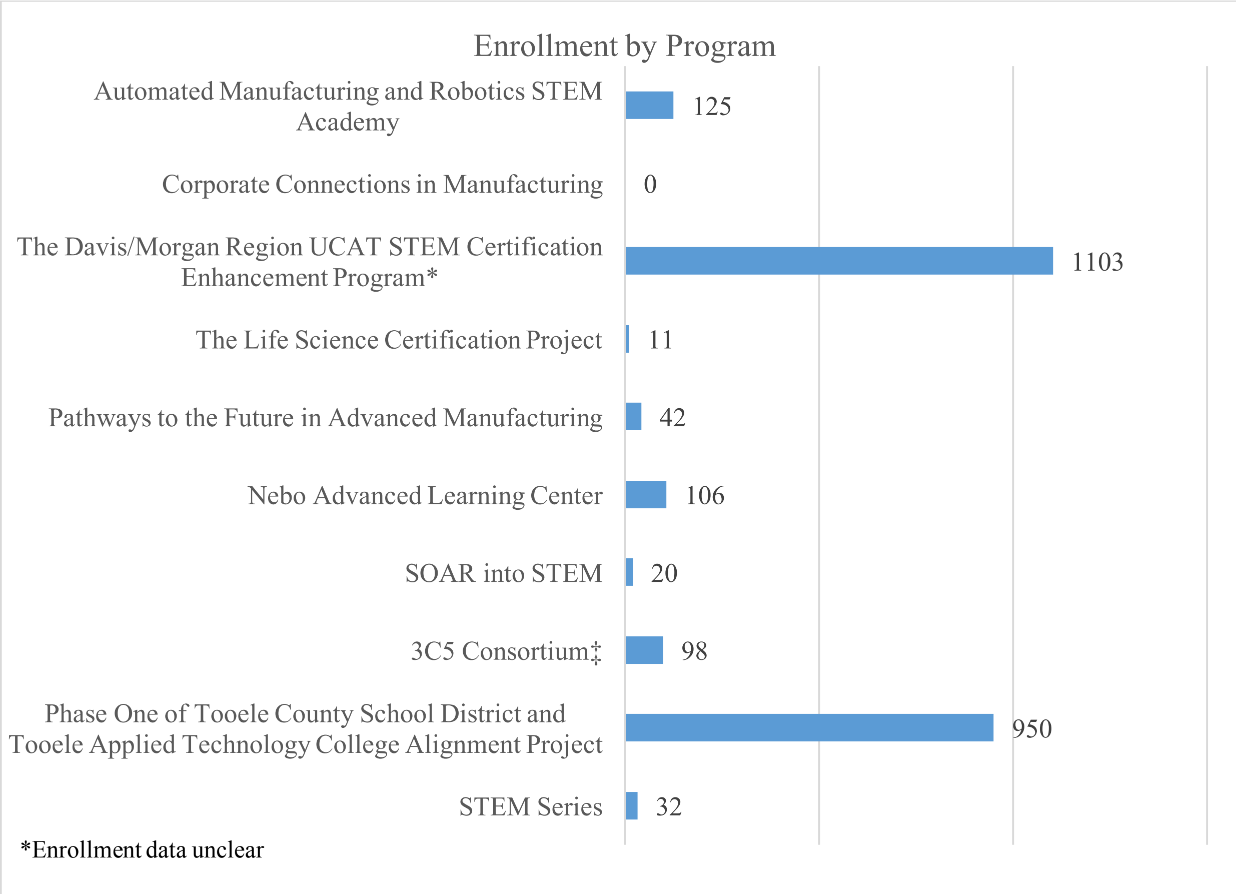


Figure 57. Enrollment by Grant Program

As seen in Figure 57, The Davis/Morgan Region UCAT STEM Certification Enhancement Program had the greatest number of students enrolled. This enrollment data, however, is unclear given that the grant proposal only requested funds for teacher professional development and 50 student scholarships. The second largest enrollment was the Tooele Alignment Project, which had more than 7 times the number students enrolled than any other program. Excluding Corporate Connections in Manufacturing, The Life Science Certification Project had the fewest number of students enrolled with 11.

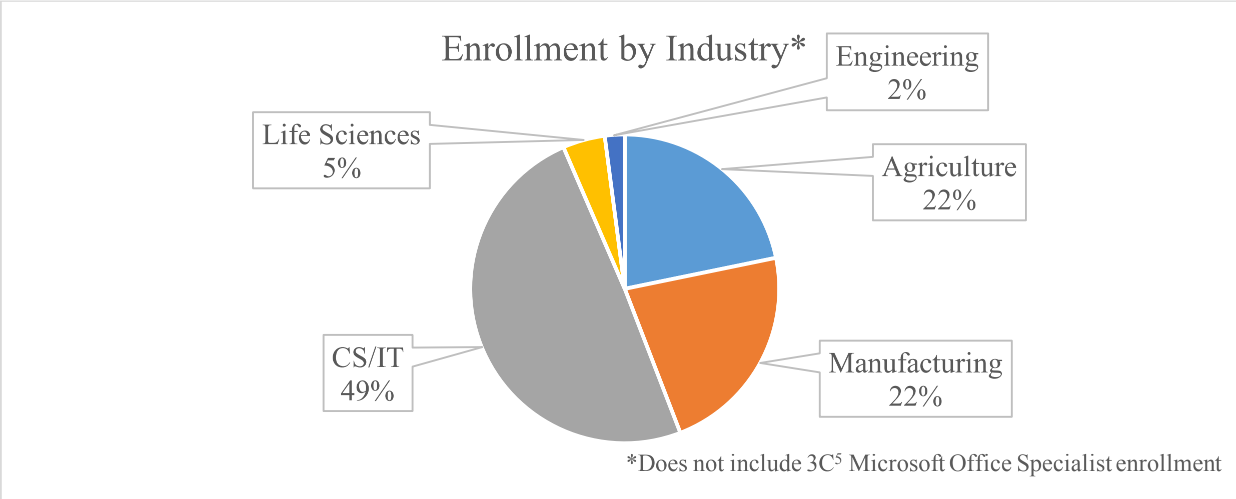


Figure 58. Enrollment by certification industry

Figure 58 shows that the majority of students were enrolled in a Computer Science/Information Technology certification program. Manufacturing and Agriculture industries had the next highest enrollment at 22% each. Engineering was the least represented industry with only 2% of students enrolled.

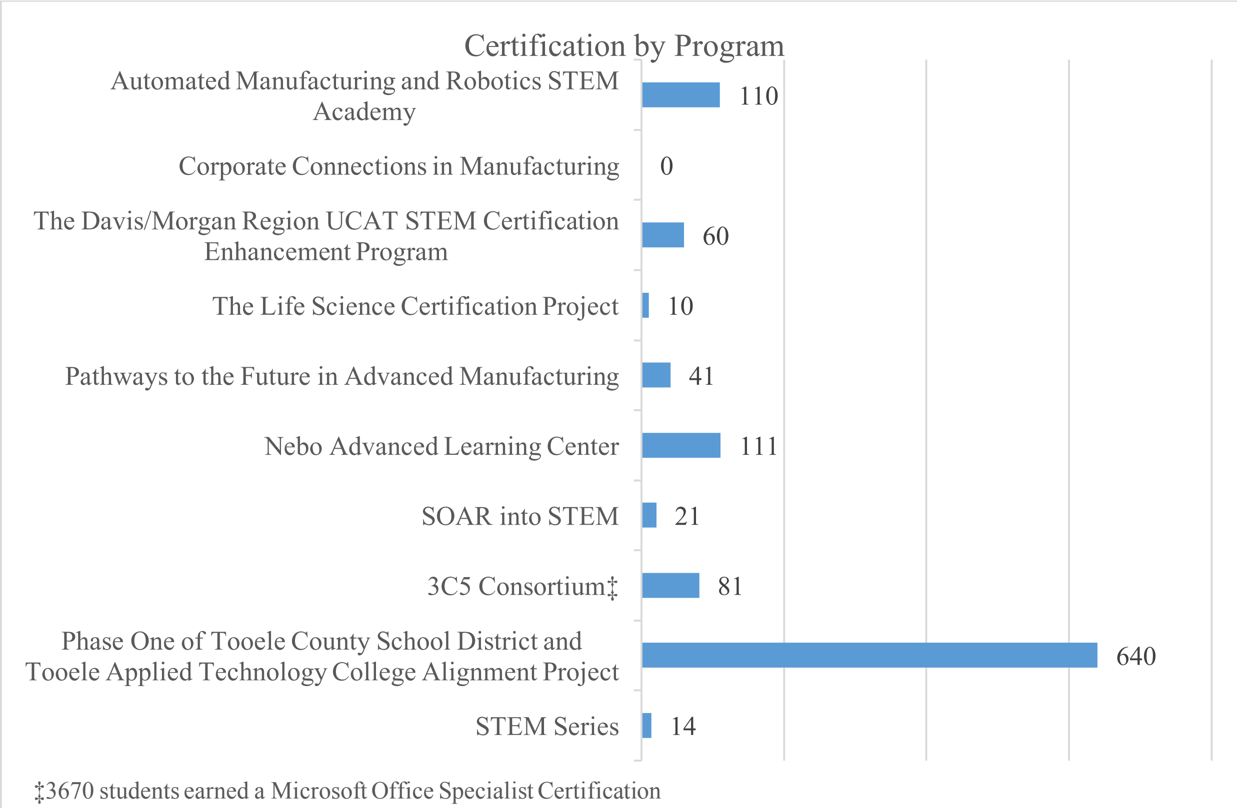


Figure 59. Certifications earned by grant program

From Figure 59, it is easy to see that The Tooele Alignment Project awarded the greatest number of certifications. This is not surprising given that The Tooele Alignment Project had the second greatest number of students enrolled. It seems that, as expected, a greater number of students enrolled in a program leads to a greater number of certifications awarded.

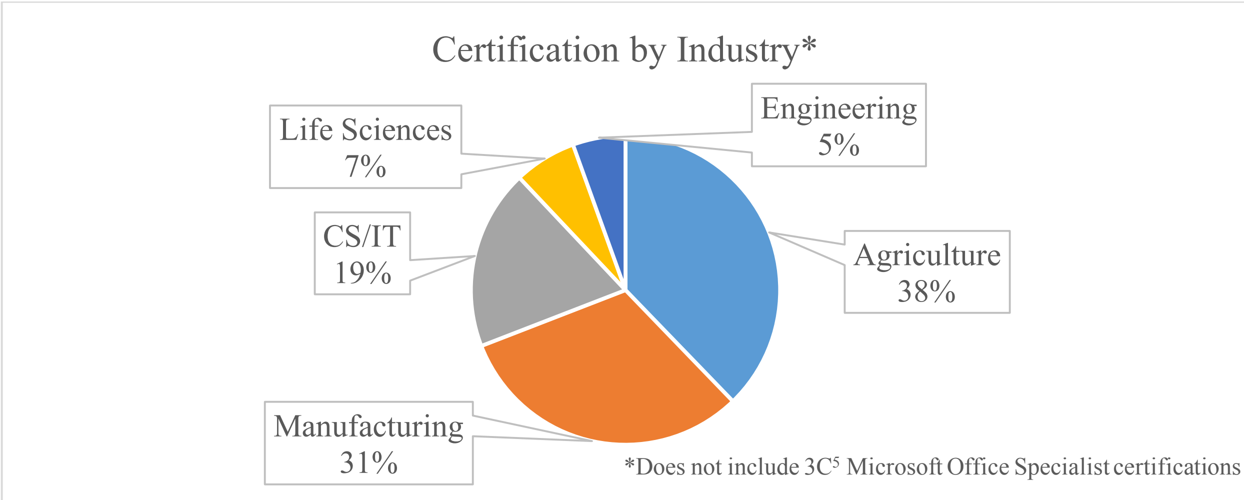


Figure 60. Certifications earned by certification industry

In Figure 60, we can see that, with 38%, the majority of certifications earned were in the Agriculture industry. This is unexpected given that 22% of students were enrolled in an Agriculture certification program. With 31% of certifications the Manufacturing industry had nearly an equal share of certifications as Agriculture did, which is consistent with enrollment. 49% of students were enrolled in a Computer Science/Information Technology certification program, but only 19% of certifications awarded were in the Computer Science/Information Technology industry suggesting a high rate of incompletion.

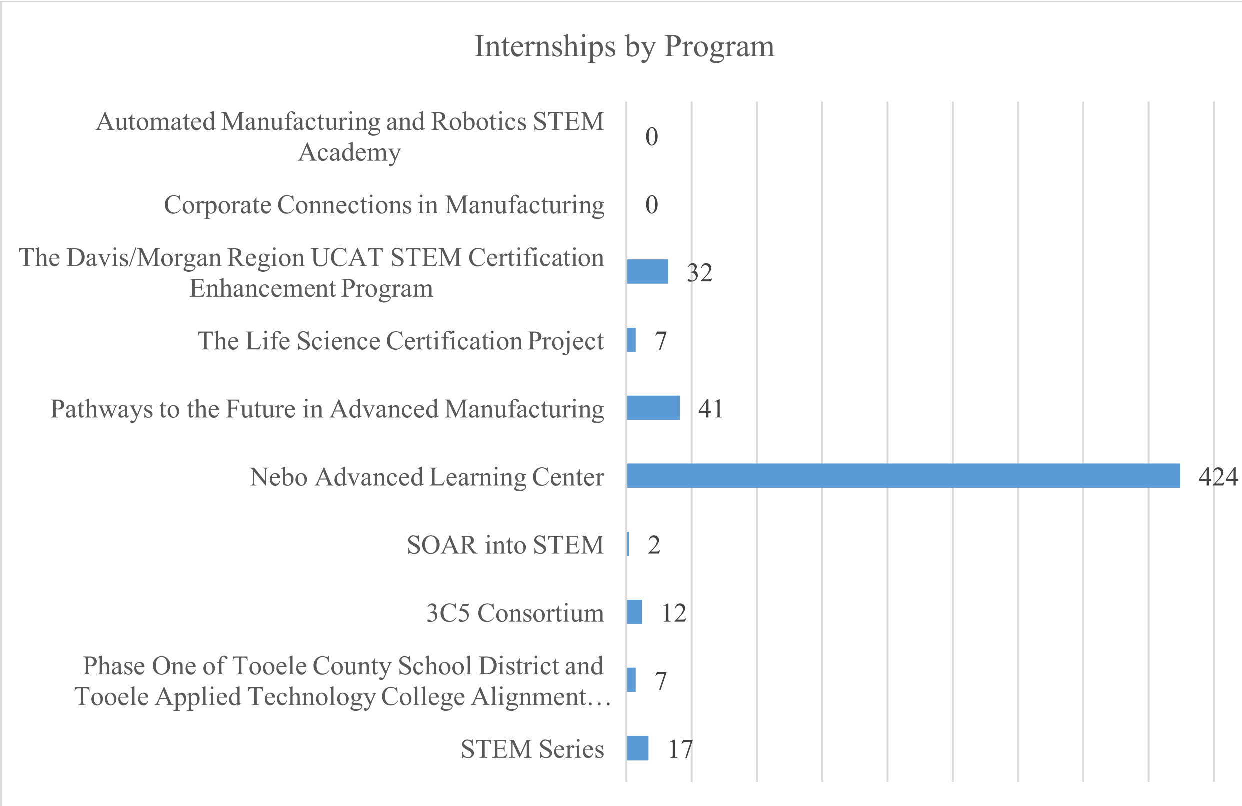


Figure 61. Internships earned by grant program

A total of 541 internships were awarded to students with the majority, 424, being awarded to students participating in the Nebo Advanced Learning Center. The Nebo Advanced Learning Center program was an expansion project and, therefore, it is unclear how many internships resulted from the expansion. Every student that earned a certification from The Pathways to the Future in Advanced Manufacturing Program received an internship (see Figure 61).

Automated Manufacturing and Robotics STEM Academy

The Automated Manufacturing and Robotics STEM Academy provided a single certification to students with the goal of continuing education towards completion of BATC's Automated Manufacturing Program. 125 students enrolled in the program, or 1.47% of students in participating LEAs. 42 students completed the certification, 68 students are working towards certification completion, and 15 students did not complete the certification (see Figure 62). The program has not resulted in any reported internships. This program will continue into the 2016-2017 year.

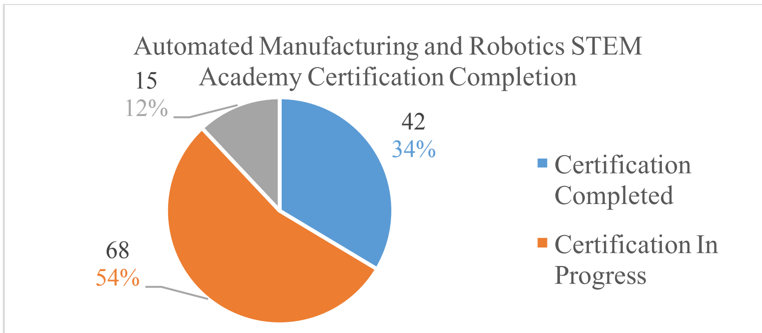


Figure 62. Automated Manufacturing and Robotics STEM Academy Certification Completion

Corporate Connections in Manufacturing

The Corporate Connections in Manufacturing grant program produced no student deliverables. Curriculum development was not completed because relationships between partners deteriorated. Teachers were trained to deliver the Manufacturing Principles course. The Corporate Connections in Manufacturing grant program received a $375,000 grant. $200,000 was recovered by the STEM Action Center.

The Davis/Morgan Region UCAT STEM Certification Enhancement Program

The Davis/Morgan Region UCAT STEM Certification Enhancement Program offered 7 certification programs. It also offered $1,000 Scholarships to the DATC for students to complete a certification program of their choice after graduation. The program has sent enrollment data that includes 1,103 students. The program has a participation rate of 5.07%. It is unclear if this enrollment data is related to the grant. 60 certifications were awarded, and 32 students earned internships. 1,023 students were enrolled in a Digital Media Adobe Certification program. This year the program awarded 36 scholarships to be used within 3 years, with a total of 50 scholarships will be awarded. This program will continue into the 2016-2017 year. An enrollment summary is represented in Table 57 and Figure 63.

Certification Program	Enrollment
Composite Material Technology	32
DATC Scholarship	36
Dental Hygiene Assistant	1
Digital Media Adobe Certifications	1023
Digital Media Design	2
Emergency Services	3
Information Technology	3
Nurse Assistant	19
Total	**1103**

Table 57. Davis/Morgan Region UCAT STEM Certification Enhancement Program enrollment

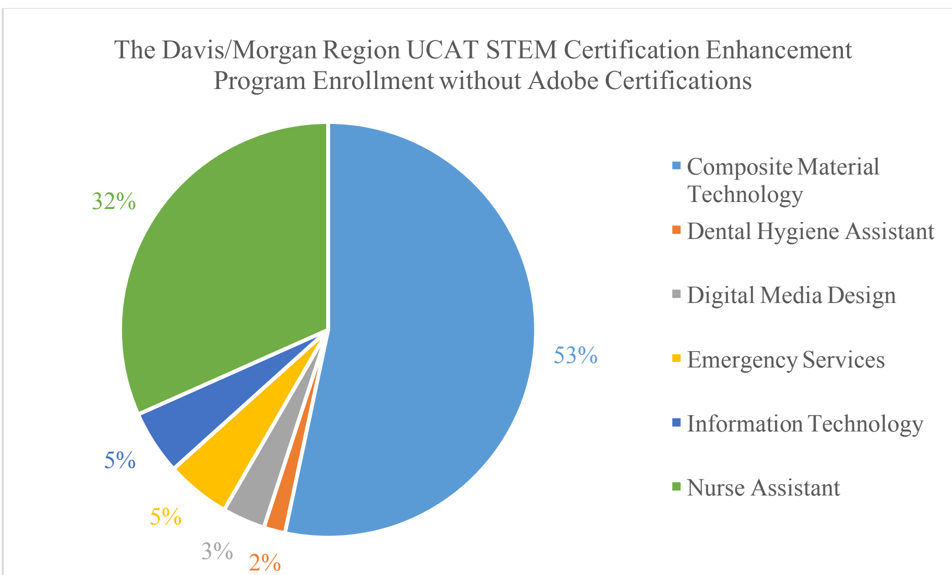


Figure 63. Davis/Morgan Region UCAT STEM Certification Enhancement Program enrollment without Adobe Certifications

The Life Science Certification Project

The Life Science Certification Project offered students two certifications: Engineering and Bio-Technology, and this program will continue into the 2016-2017. The program had 11 enrolled students, with a participation rate of 0.06%. 10 certifications were earned and 7 internships were completed. Figure 64 shows the distribution of certifications earned.

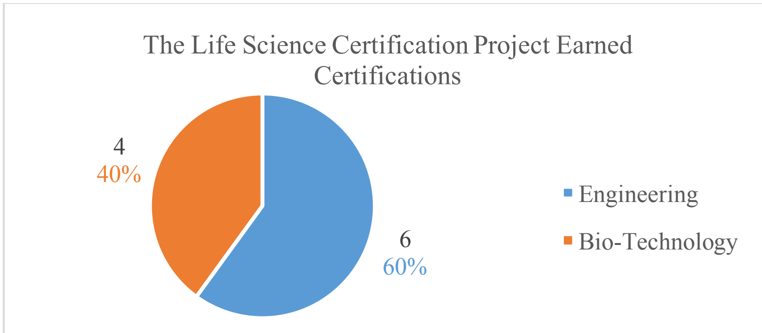


Figure 64. The Life Science Certification Project earned certifications

Pathways to the Future in Advanced Manufacturing

The Pathways to the Future in Advanced Manufacturing offered students a chance to earn the Utah Aerospace Pathways Certification. A total of 42 students were enrolled in the programs. This is a participation rate of 0.07%. 41 students completed the certification. Each student that completed the certification obtained an internship at one of 5 companies. The companies that offered internships to students are the following: Albany, Boeing, Hexcel, Janicki, and Orbital ATK. This program will continue into the 2016-2017 year. Figure 65 shows the distribution of internships completed.

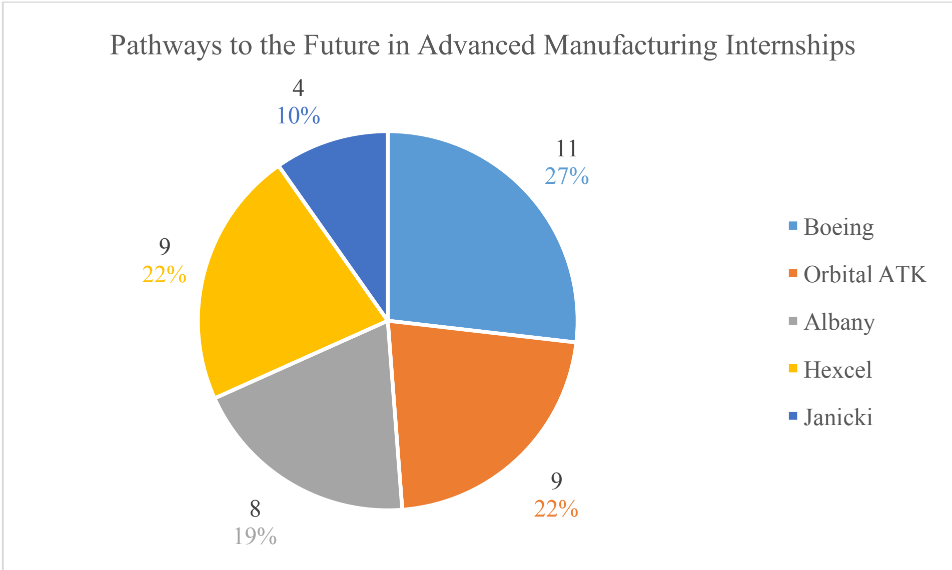


Figure 65. Pathways to the Future in Advanced Manufacturing internships

Nebo Advanced Learning Center

The Nebo Advanced Learning Center offered students 6 certifications in 5 different programs funded by this grant. The Nebo Advanced Learning Center offers career pathway courses in a sixth program that was funded through another grant. A total of 106 students were in enrolled in the programs funded by the STEM Action Center grant. This is a participation rate of 1.12%. 111 certifications were completed. The Nebo Advanced Learning Center also reported 447 career pathways and 424 internships were completed; however, it is unclear if these career pathways and internships were a result of this grant. This program will continue into the 2016-2017 year. Figure 66 shows the distribution of certifications by program.

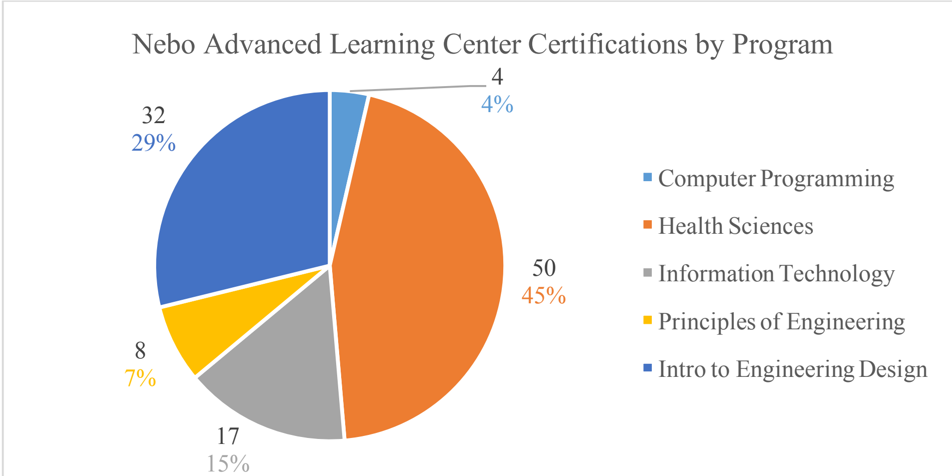


Figure 66. Nebo Advanced Learning Center certifications by program

SOAR into STEM

The SOAR into STEM program offered students 3 certifications: Advanced Composites, Pre-Engineering, and Programming/Software Development and will continue into the 2016-2017 year. Data was only received from Ben Lomond High school and may have been incomplete. The program had a total of 20 students enrolled and a participation rate of 0.56%. 17 certifications were completed and 4 are still in progress. In the program, 2 internships were earned by students , 1 was completed, and 1 is still in progress. This program will continue into the 2016-2017 year. Figure 67 shows the distribution of certifications earned or in progress.

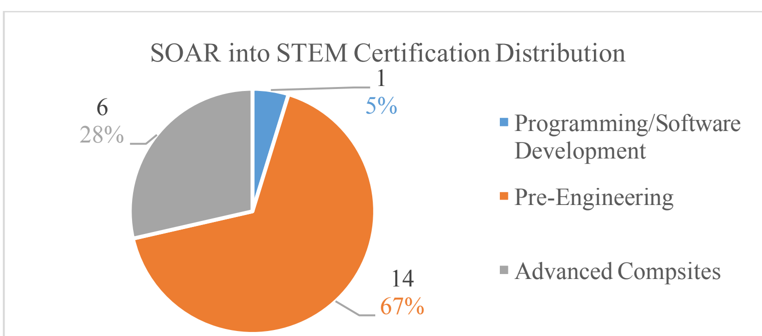


Figure 67. SOAR into STEM certification distribution

3C⁵ Consortium

The 3C⁵ Consortium program offered 12 computer science certifications to students. 98 students were enrolled in the program; this is a participation rate of 0.85%. 81 certifications were completed, 169 certifications were not completed, and 12 internships were completed. This grant also funded professional development to teachers in Washington County School District in order to increase the pass rate of the Certiport Microsoft Office Specialist test. This year 4,335 students took the test and 3670 students passed the test, resulting in an 84% pass rate, the highest in the State of Utah. If the Microsoft Office Specialist enrollment is included the programs had a participation rate of 38.43%. Figure 68 shows the distribution of certifications earned excluding the Microsoft Office Specialist certifications.

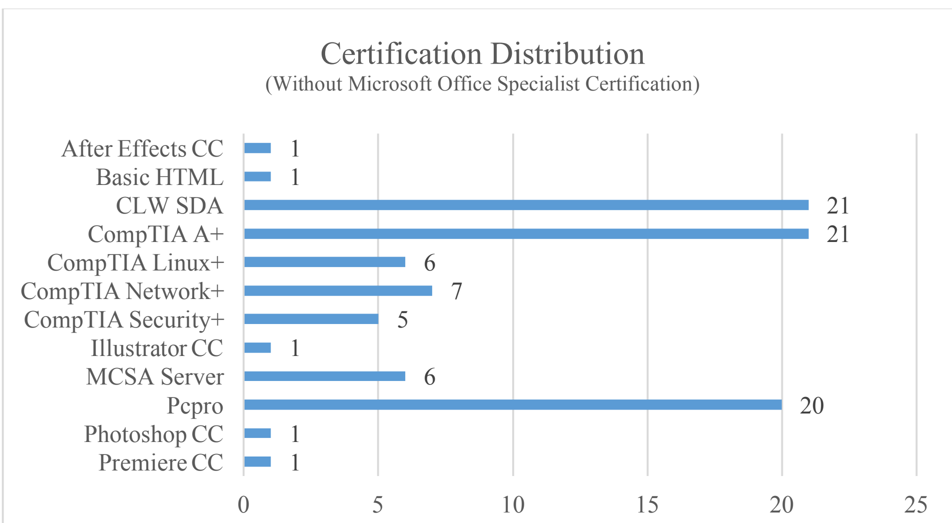


Figure 68. 3C⁵ Consortium certifications without Microsoft Office Specialist certifications

Phase One of Tooele County School District and Tooele Applied Technology College Alignment Project

The Phase One of Tooele County School District and Tooele Applied Technology College Alignment Project offered students 17 courses that have been developed to align with courses at Tooele Applied Technology College. These courses offered certifications in 4 industries: Agriculture, Computer Science/Information Technology, Life Science, and Manufacturing. A total of 950 students were enrolled in the program. This is a participation rate of 21.67%. 640 certifications were completed, 731 certifications were not completed, and 7 internships were completed. Figure 69 show enrollment by course, and Figure 69 shows the distribution of certifications earned.

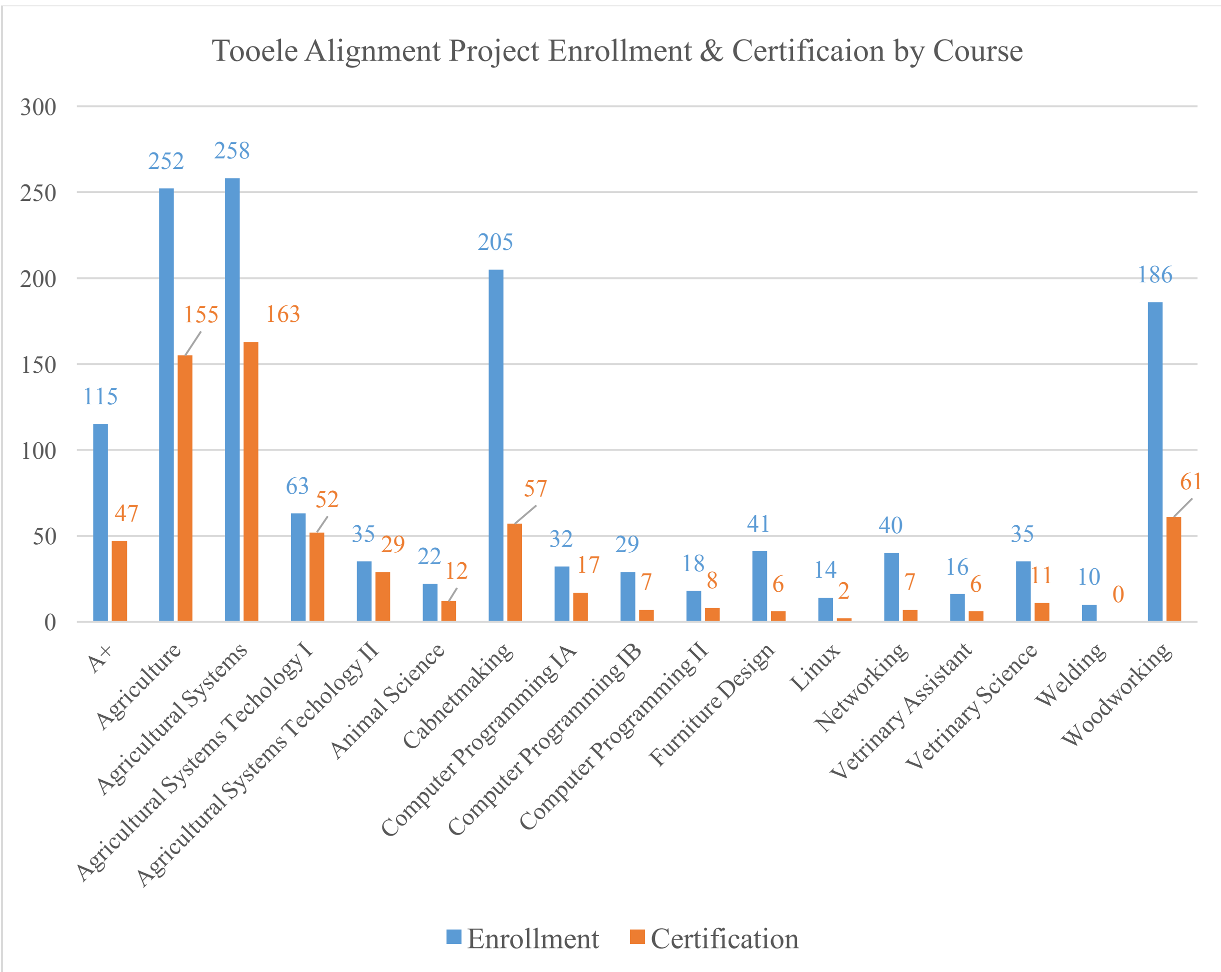


Figure 69. Tooele Alignment Project enrollment and certification by course

STEM Series

The STEM Series programs were started in Spring 2015 and extended into the 2015-2016 school year. The program offered students a Launchpad certification. In the 2015-2016 school year, 32 students were enrolled in the program. This is a participation rate of 0.37%. 14 students earned new certifications and 17 students completed an internship. Students earned internships at 10 different companies. Figure 70 shows the distribution of internships.

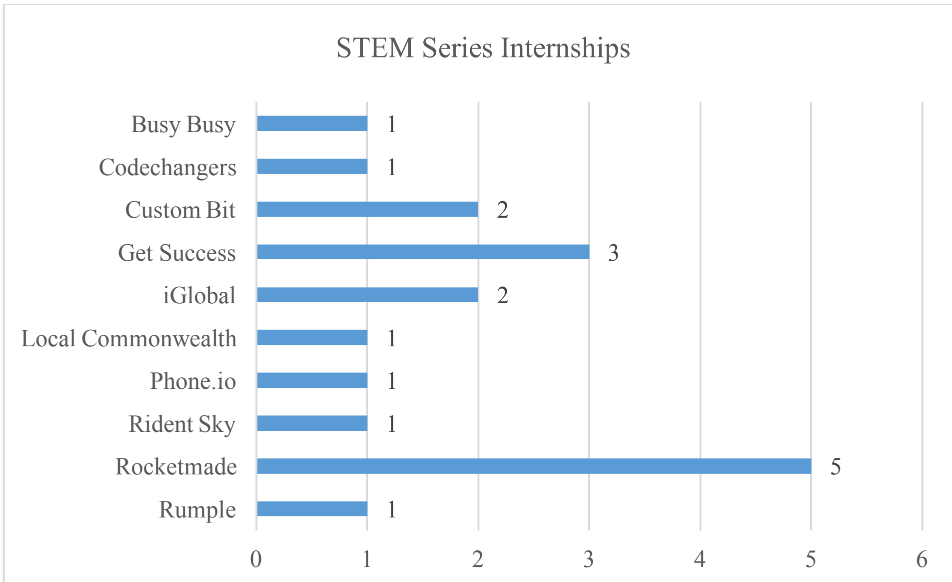


Figure 70. STEM Series internships

Survey

In December 2015, a survey was sent to teachers and students participating in a High School STEM Industry Certification Program. Teachers were asked to list two or more strengths of the High School STEM Certification program or career pathway program they were participating in as an instructor. Some notable responses follow:

- "Allows students to participate in classes that can lead to professional certification without having to pay 'technical college' fees for similar classes."
- "Allows students to learn skills (programming/web design/coding) to a level of proficiency that will likely be useful to them as part of a science career that are traditionally not taught during high school."
- "Our curriculum is approved by local industry experts, and through this we are well connected with employers to help students get jobs."

Teachers were also asked to list at least one thing that could be improved about the High School STEM Certification program or career pathway program in which they were participating as an instructor. Some notable responses follow:

- "Orientation Program for the students and parents before the class starts"
- "Guest speakers in the field to come once or twice during the semester to answer questions about the field"
- "I think we need to try to build a stronger female presence in the field. As a woman who graduated with a BS in GIS, I feel as though we need a stronger presence of woman."
- "We need to offer more classes in our program"
- "The resources needed to teach advanced programming and maintenance are lacking. For example, the ability to set up a small network the students can manipulate does not currently exist."

Students were asked to list at least one thing that could be improved about the options they have either at school or through participation in a STEM certification program. Some notable responses follow:

- "If school would give you electives that applied to your future career, it would help everyone to be better at their jobs."
- "One thing that I think can be improved is helping students have a plan for the job/career path they choose. If there are programs that help plan the students path they need to take to get to a certain point, then I feel the students will be more prepared and have a better knowledge of the path they are taking."
- "Help with placement into internships or entry level jobs."
- "I would like a little bit of more applied learning to actually see things like a server room and have real life problems shown to us."

Student and teacher survey responses were positive. Both students and teachers were pleased with the programs in which they participated. The main theme of responses regarding improvement was expansion of such programs. Both students and teachers want more courses, more equipment, and more opportunities.

Conclusion

It should be stated that each of these programs are elective for students. These programs do not involve core courses and as such serve fewer students. We know that in participating LEAs 6% of students choose to participate in the grant programs. Without a baseline, we are not able to adequately interpret what 6% means. We know that 4,791 certifications have been earned and that 639 internships have been completed. It is assumed that these certifications and internships improve a student's chances of obtaining employment. We do not, however, have data to support or oppose this assumption. With the assumption that these certifications and internships are valuable to students we should seek to improve the participation rate. This year, 5 of the 10 programs evaluated used a portion of their funding for marketing and promotion. Those five programs had an average participation rate of 0.60%. The other five programs had an average participation rate of 7.06%. Without a baseline participation rate for each program, and a knowledge of marketing practices, it is impossible to determine if marketing was effective.

Recommendations

The High School STEM Industry Certification Program seems to be successful. Because of this program, 6,919 students have been exposed to industry recognized certification programs, 4,791 industry recognized certifications have been earned, and 639 internships have been completed. This program has been supported by applied technology colleges, universities, and industry partners, and there seems to be a great need for successful programs of this nature. As such, great effort should be applied to involving as many students as possible in each program. Because of a lack of previous data, it is impossible to determine the effectiveness of current marketing and recruitment practices, we now have data to compare to any future industry certification programs. It is our recommendation that future programs be required to provide a detailed marketing and recruitment plan based on proven practices in order to engage more students.

In order to dispense the developed curriculum to the maximum number of students we also recommend that the STEM Action Center make curricula available to the Utah State Board of Education (USBE) to distribute developed curricula to LEA's throughout the state and provide professional development in order to implement the curricula. This will allow the curricula that was developed through these programs to be made available to every high school student in the state.

References

3C5 Consortium. (2014). *High School Student STEM Certification Request for Grant Application.* Salt Lake City: STEM Action Center.

About DATC. (2016, July 28). Retrieved from Davis Applied Technical College Web Site: http://www.datc.edu/about

Bear River Region High Schools. (2014). *High School STEM Ceritification Request for Grant Application.* Salt Lake City: STEM Action Center.

Bishop, J. H., & Mane, F. (2004). The impacts of career-technical eduation on high school labor market success. *Economics of Eduation Review, 23*, 381-402.

Brasiel, S., & Martin, T. (2015). *STEM Action Center Grant Program Annual Evaluation Report.* Logan, UT: Utah State University.

Davis and Morgan County School Districts. (2014). *Davis and Morgan School Districts High School STEM Certification Grant Project Proposal.* Salt Lake City: STEM Action Center.

Granite School District. (2014). *High School Student STEM Certification Request for Grant Application.* Salt Lake City: STEM Action Center.

Gray, K. (2004). Is High School Career and Technical Education Obsolete? *The Phi Delta Kappan, 86*(2), 128-134.

Lynch, R. L. (2000). High School Career and Technical Education for the First Decade of the 21st Century. *Journal of Vocational Education Research, 25*(2).

Nebo School District. (2014). *High School Student STEM Certification Request for Grant Application.* Salt Lake City: STEM Action Center.

Ogden City School District. (2014). *SOAR Into STEM.* Salt Lake City: STEM Action Center.

Southeast Region Consortium. (2014). *Proposal to the State of Utah STEM Action Center High School Student Stem Certification.* Salt Lake City: STEM Action Center.

STEM Action Center. (2014-2016). Data Collected From Grant Awardees . Salt Lake City, Utah.

Tooele County School District. (2014). *High School Student STEM Certification Grant Application.* Salt Lake City: STEM Action Center.

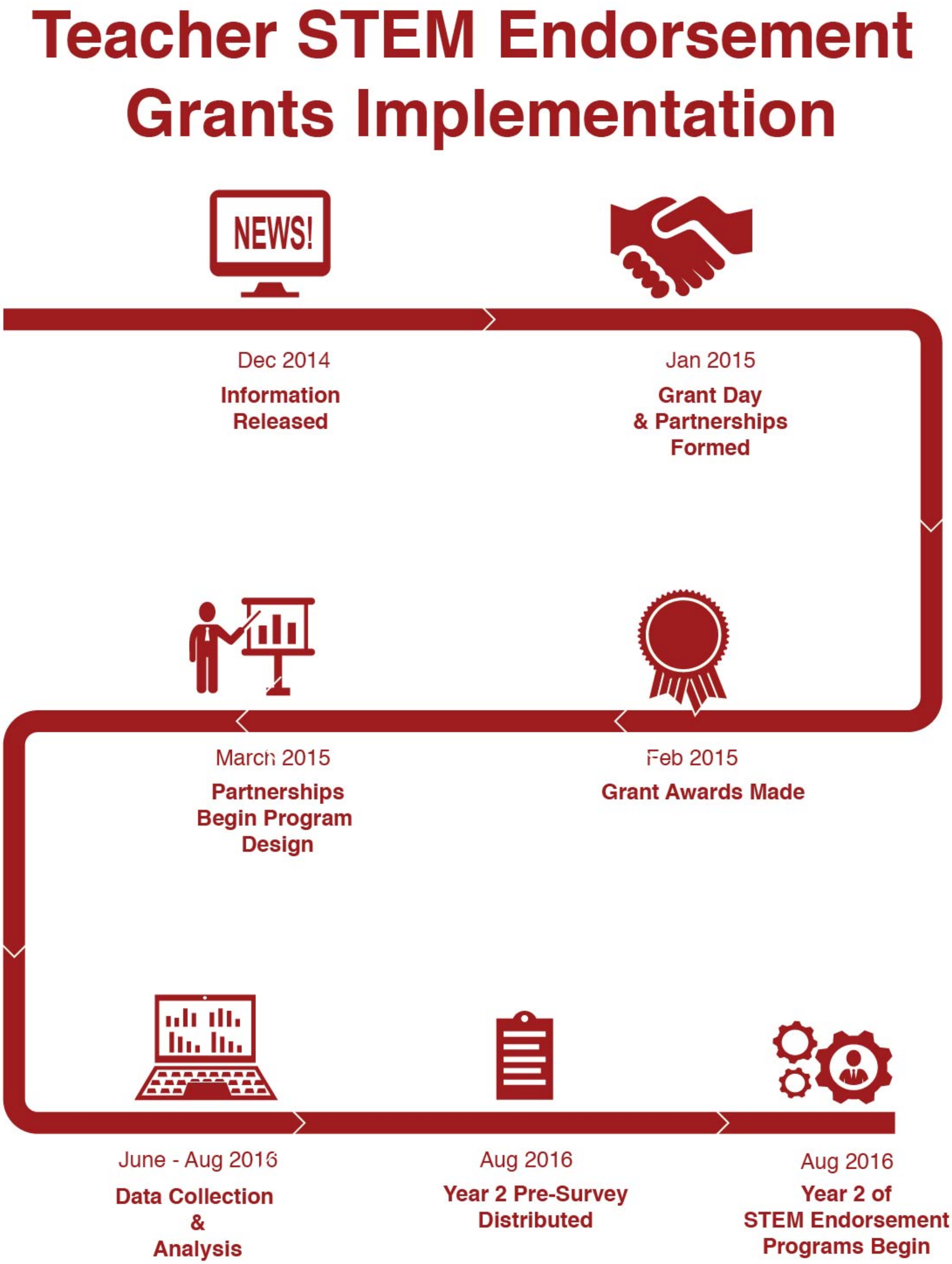
USBE. (2015, October 1). *Data Reports - Enrollment and Demographics.* Retrieved from Utah State Board of Education: http://www.schools.utah.gov/data/Reports/Enrollment-Demographics.aspx

Utah Department of Workforce Services. (2014, June). *Utah Industry Projections 2012-2022*. Retrieved from Utah Departement of Workforce Services: http://jobs.utah.gov/wi/statewide/statewidelongtermproj.html

Wasatch Front South Region Districts. (2014). *High School STEM Certification Request for Grant Application.* Salt Lake City: STEM Action Center.

Washington County School District. (2014). *STEM Series Grant Application.* Salt Lake City: STEM Action Center.

Chapter 6 - STEM Endorsement Grants



Introduction

The Utah legislation titled House Bill (H.B.) 150, passed in 2014, authorized the STEM Action Center and the State Board of Education to "develop STEM education endorsements" and to "create and implement financial incentives for an educator to earn an elementary or secondary STEM education endorsement." (HB 150, 2014). These endorsements provide funding by which educators can complete STEM related coursework at local Institutes of Higher Education (IHEs). Each of the seven university and LEA partnerships that administer the program on the local level will conduct their own internal evaluation of the program's success (Brasiel & Martin, 2015).

In conjunction with these internal evaluations, an external evaluation will be conducted using the SAGE scores of the students whose teachers participated in the program (GOED, 2015). A statistical analysis of the impact of the STEM endorsement program on SAGE scores will be provided in future STEM Evaluation Reports, once the necessary data is available and its reliability ensured. The external evaluation will also include an analysis of the survey data of participating teachers, as well as whether the information provided in the internal evaluations indicates any improvement in STEM teaching ability.

The following section provides background information of the STEM endorsement program, as well as brief commentary of how this knowledge informs the forthcoming external evaluation. The concluding passage will provide a brief overview of current teacher participation in the program. The organization of this section is as follows:

- Administrative Structure and Financing of the STEM Endorsement Program
- Timeline of the Emergence of the STEM Endorsement Program
- Differences in Programs Implementation Across Partnerships
- How the STEM Endorsement program will be evaluated on both the Local and State level in future years.
- Update on the level of teacher participation across school districts.

Administrative Structure and Financing of the STEM Endorsement Program

The State Board of Education collaborates with the STEM Action Center to administer the STEM endorsement program (HB 150, 2014). To facilitate the program's objectives, seven partnerships between local education agencies (LEAs) and nearby IHEs have been arranged. Each partnership implements the program in a way that they perceive as being accommodating to local objectives and institutional constraints. Teacher's eligible to participate in the program for STEM endorsement training do so through the IHE with whom their school district is partnered (Brasiel & Martin, 2015). An overview of which LEAs and IHEs are partnered together is provided in Table 58. Note that the school district responsible for administering the program is known as the "Lead Partner" and is in bold in the table below.

H.B. 150 allocates "Up to $1,500,000" in "developing the STEM education endorsement and [the] related incentive program…" (HB 150, 2014). Each partnership was awarded $100,000 per year for 2 years to serve the first cohort of up to 332 teachers (GOED, 2015). Currently, the funding for each partnership is scheduled to be distributed across three fiscal years (FY15, FY16, FY17) (Brasiel & Martin, 2015).

Partnering University	Partnering Districts
BYU	**Alpine**, Wasatch, and Nebo School District

WSU	**Davis**
USU	**Weber**, Box Elder, Cache, Emery, Grand, Logan, Ogden, and Uintah School District
UVU	**Provo** and Park City School District
U of U	**Salt Lake City** and Granite School District
DSU	**Washington County School District**
SUU	**Southwest Education Development Center,** Iron, Canyons, Jordan, Washington, Garfield, Millard, and Kane School District
Source: (Brasiel & Martin, 2015) Note: The school district in charge of administering the program on the local level is called the "Lead Partner" and is bolded in the table above. With the exception being Southwest Education Center, which is not a school district but rather an organization that "provides services requested by our member schools … in southwest Utah" Note: Most of the partnerships now include some charter schools in the program	

Table 58. Overview of Partnerships for the STEM Endorsement Program

Timeline of the STEM Endorsement Program

In December 2014, information was provided to school districts regarding the grant application process for the STEM endorsement program (Brasiel & Martin, 2015). In January of 2015 a "Grants Day" meeting was organized in which district leaders circulated among IHE representatives to discuss partnerships opportunities. Grant applications were due later that month followed by the awarding of funds in February 2015.

In March, the partnerships began planning the particulars of how the program would be implemented in their jurisdiction. This was in preparation for the teacher recruitment initiatives that would begin the following month. In June, meetings were held to discuss the details of how the program would be evaluated. In August the STEM Endorsement program officially began, with the first cohort of teachers taking classes from their partnered IHE (Brasiel & Martin, 2015).

Differences in Program Implementation between Partnerships

The primary goal of the forthcoming STEM endorsement evaluation is to determine whether a teacher's participation in the STEM endorsement program improves SAGE test scores for his or her students. In order to make a causal claim regarding this matter, we must be attentive to aspects of the program's implementation that have the potential to introduce any form of selection bias into the data. Selection bias in this context means that the cohorts in the STEM endorsement program are unrepresentative of those of the typical teacher. For instance, if eligibility for the program is stipulated on the teacher's previous performance, high performing teachers may be overrepresented in the program. If this is the case it would be erroneous to simply compare those who participated in the program with those that didn't, given that these participants may have had higher SAGE scores to begin with. In addition, because a teacher's participation in the program is purely voluntary, we can be confident that at least some form of self-selection bias is pervasive throughout the data.

To be vigilant against these vulnerabilities requires careful documentation of the differences in the program's implementation across partnerships. This subsection compares the differences in the programs administration across three significant dimensions: recruitment, tuition, and method of delivery. The goal of this is to identify procedures that may exclude certain demographics of teachers from participating in the program and thus exacerbate the selection bias problem mentioned previously.

Understanding the differences in the particulars of how the program is carried out is of interest in another important way. If we find strong variation in the effectiveness of the STEM Endorsement Program across partnerships, even after controlling for differences in student demographics, a natural follow-up investigation would be an examination of the effect that local administration has on the program effectiveness. As a purely hypothetical example, if certain types of teachers benefit from STEM endorsement training while others do not, then the recruitment procedures of successful partnerships may become informative in future policy design.

Differences in Recruitment across Partnerships

A familiarity of the criteria used to authorize or exclude certain teachers from participating in the STEM endorsement program is necessary in order to be alerted to the possibility of selection bias in the data. More precisely, we are interested to see if the selection criteria of a particular partnership exclude teachers based on their SAGE scores either directly or indirectly. Table 59 provides the recruitment criteria of the seven partnerships.

Partnership	Teacher Recruitment
BYU with Alpine School District, Wasatch, and Nebo School District	No recruitment criteria
WSU with Davis School District	The partnership will recruit individuals or collaborative groups that ● Showing Promise of Sustained Interest ● Ability to Lead ● Are from high-need schools showing a broad base of wanting STEM training
USU with Weber, Box Elder, Cache, Emery, Grand, Logan, Ogden, and Uintah School District	Each partnering district (8 total) will be allowed to use their own criteria for selecting participating teachers.
UVU with Provo School District, Park City School Districts	The partnership will take applications from individual teachers, who will then be selected based upon interviews conducted by partnership representatives.
U of U with Salt Lake City, Granite School Districts	Teachers selected based on their ● Teaching and Leadership experience ● A written statement of their teaching and leadership goals ● An administrator's recommendation ● A Signed statement of commitment to the program
DSU with Washington county School District	Left to the discretion of the district and charter school partners

SUU with Southwest Education Development Center (Iron, Canyons, Jordan, Washington, Garfield, Millard, Kane School Districts)	Willing to work with anyone
Source: (Brasiel & Martin, 2015) Note: 6 of the 7 partnerships reported plans to recruit at charter schools. Note: "Lead Partner" in bold	

Table 59. Recruitment Criteria by Partnership

We see that the selection criteria are not uniform across partnerships with some districts providing funds based on "teaching and leadership experience," while others have "no recruitment criteria". As discussed previously, the inclusion criteria have the potential of introducing selection bias into the data. The possibility of bias in representation will be taken into account when evaluating the effectiveness of the STEM endorsement program during next year's report.

Differences in Tuition and Method of Delivery

The various partnerships provide differing tuition breaks to those participating in the STEM Endorsement Program. This has the potential of discouraging certain kinds of teachers from participating in the program and thus it is appropriate to document these differences carefully. For instance, a partnership that provides lower tuition assistance for its teachers may discourage those that earn less from participating. Given that teachers that earn less also tend to be less experienced, the end result could be an underrepresentation of less experienced teachers in the program.

The method of delivery could also influence the composition of teachers choosing to enroll in the program. The distance to the nearest IHE may be a prohibiting factor for certain teachers and thus influence the demographic makeup of the teachers opting in. Table 60 below provides information on tuition and the method of delivery available in each partnership.

Partnership	Tuition	Online courses	Face to Face Courses	Blended*: Online + F2F
BYU with Alpine, Wasatch School Districts	$360.00 per teacher per course	No	Yes	No
WSU with Davis School District	$240.00 per teacher per course	No	Yes	No
USU with Weber, Box Elder, Cache, Emery, Grand, Logan, Ogden, and Uintah School District	$155.00 per teacher per course	Yes	Yes	Yes
UVU with Provo School District, Park City School Districts	Teachers will receive a stipend of $250.00 per course, and pay a 1 time fee of $35 and $45.00 per course.	Not Addressed in the Proposal	Not Addressed in the Proposal	Not Addressed in the Proposal
U of U with Salt Lake City, Granite School Districts	The grant covers teacher tuition – but teachers will need to pay a $50 recording fee per course.	No	Yes	No
DSU with Washington county School District	The grant covers teacher tuition – no other fees are expected	Not Addressed in the Proposal	Not Addressed in the Proposal	Not Addressed in the Proposal
SUU with Southwest Education Development Center (Iron, Canyons, Jordan, Washington, Garfield, Millard, Kane School Districts)	Teachers will receive a $500.00 stipend for the 2 years, intended to cover course recording fees	No	No	Yes
Source: (Brasiel & Martin, 2015) Note: “Blended” means courses that are a mix of online and face to face instruction				

Table 60. Tuition and the method of delivery by partnership

Future Evaluation of STEM Endorsement Grant

Given that the first year of the STEM Endorsement program was recently completed, both internal and external evaluations are not provided at this time. For proper analysis, adequate time must pass between the first cohort’s entry into the program (August, 2015), and the time of evaluation to ensure that the effects of the program are fully realized (Gulamhussein, 2013; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). Justification of this is based on the acknowledgement that a teacher's implementation of new STEM teaching methodologies, acquired through their coursework, will likely be implemented in the year following their initial participation in the endorsement program. While some teachers may have adopted these methodologies throughout the course of the year, we anticipate any major impacts on student outcomes will occur following their first full year of participation in the endorsement program. As a result, it would be premature to draw conclusions concerning the efficacy of the program at this time. The following section details the intended methods of assessment that will be conducted in the next evaluation cycle.

Internal Evaluation

As mentioned earlier, the STEM Action Center requires each grantee to conduct their own internal evaluation (Brasiel & Martin, 2015). The table below documents how the different partnerships intend to evaluate the success of the STEM Endorsement program. We will be working with the partnerships to obtain the results of their internal evaluations as they become available.

Program Evaluation	Evaluation Measures and Design
BYU with Alpine, Wasatch School Districts	● Grades from coursework of participating teachers ● Pre- and post-surveys of teachers' confidence in teaching STEM subjects ● Changes in student's scores from SAGE as well as classroom average scores from SAGE ● Surveys from parents and students; formal and informal classroom observations; conversations with participating teachers.
WSU with Davis School District	● Pre- and post-tests of teachers' STEM content knowledge (matter, force, engineering, data analysis, problem solving, the nature of science). ● Changes in the content of teachers' lesson plans.

	● Data from observations of teachers' classrooms (videotaped) and also and observation protocol. ● Students' SAGE scores and other district tests. ● Analysis of students' STEM projects. ● District teacher evaluations and WSU course evaluations.
USU with Weber, Box Elder, Cache, Emery, Grand, Logan, Ogden, and Uintah School District	● Use of mixed methods; cross section, pre- and post-measures, multiple repeated measures; effect sizes ● Changes in teachers' STEM content knowledge; instrument developed by Nadelson & colleagues to measure changes in teachers' knowledge of core STEM teaching practices ● observations of teaching practices using observation protocol (level of inquiry, level of engineering design); ● teacher's level of participation in STEM education leadership.
UVU with Provo School District, Park City School Districts	Use of assessment instruments developed to align with policy documents such as: ● NGSS ● Interstate Teacher Assessment and Support Consortium (InTASC) Standards ● Utah Science Standards ● Utah Effective Teaching Standards ● Pre- and post-changes in suitable assessments for teachers' STEM knowledge, practice, and pedagogy
U of U with Salt Lake City, Granite School Districts	● Teacher knowledge: Content knowledge test based on the Misconceptions Oriented Standards-based Assessment Resource for Teachers and NAEP items. ● Changes in teaching practices will be measured using the self-report assessment from the Introducing Teachers and Administrators to the NGSS from NSTA. ● Changes in teacher pedagogy will be measured from teachers' lesson plans using a nationally normalized rubric.
DSU with Washington county School District	● Mixed methods: quantitative methods with analysis methods such as t-tests and ANOVA; qualitative analysis of classroom observations ● STEM content knowledge (pre- and post-tests and classroom observations using protocol) ● Teaching practice (lesson plans) ● Teacher pedagogy (alignment with NGSS Standards classroom observations) ● STEM teaching efficacy (Science Teaching Efficacy Belief Instrument)
SUU with Southwest Education Development Center (Iron, Canyons, Jordan,	● Participating teachers will experience model lessons, guest speakers, field trips and other authentic experiences ● STEM content knowledge assessment (40 "closed choice" items written by 4 STEM content and 2 pedagogy specialists); ● Teaching practice assessment (40 open response questions also written by their specialists, meant to align with NGSS teaching practice standards)

Washington, Garfield, Millard, Kane School Districts)	● Pre- and post-evaluations of lesson plans on a specific topic, evaluated for STEM practices and high quality content. ● Observations of teachers when teaching a STEM lesson, rated according to a STEM instrument, based on the Utah Effective Teaching Standards
Source: (Brasiel & Martin, 2015)	

Table 61. Evaluation measures and design by program

External Evaluation

As mentioned earlier, the external evaluation will be partially based on whether SAGE scores improved for students whose teachers participated in the STEM endorsement program. The statistical methodology to be employed is commonly known as a Difference in Difference (DD). The basis of the DD approach is to compare the differences between the "treatment" group and "control" group both before and after the treatment is implemented. In the context of evaluating the STEM endorsement program, the treatment group is the teachers that participated in the program, and the control consists of teachers that did not. DD is employed to control for 1) both the selection and self-selection bias discussed previously and 2) general trends in aggregate SAGE scores affecting all teachers in the system. A more thorough elaboration on the advantages and limitations of a DD approach will be discussed in the forthcoming report. To supplement this external evaluation, a survey designed to document the participating teacher's perceptions regarding the effectiveness of the program will be distributed.

As an aside to the discussion of whether or not the STEM Endorsement Grant will result in greater student achievement, it is noteworthy to mention that the current research literature does not strongly support nor reject the theory that additional formal education by teachers will improves classroom performance. However, keep in mind that the type of education funded through the STEM endorsement program is quite different than those that have been the focus of much of the research literature. For instance, speaking more broadly with respect to a teacher's academic credentials, Harvard's Matthew Chingos and Paul Peterson state the following: *"Neither holding a college major in education nor acquiring a master's degree is correlated with elementary and middle school teaching effectiveness, regardless of the university at which the degree was earned"* (Chingos & Peterson, 2010, p. 2).

However, they do later acknowledge that "math training may be associated with [the] effectiveness in teaching high school math" (Chingos & Peterson, 2010, p. 7). Two other researchers, Douglas Harris and Tim Sass, cite research that revives the ideal that additional training could improve instruction in elementary mathematics.

"Except for positive correlations between possession of a master's degree and elementary math achievement found by Betts et al., 2003, Dee, 2004 and Nye et al., 2004, recent research indicates either insignificant or in some cases even negative associations between possession of graduate degrees by a teacher and their students' achievement in either math or reading" (Harris & Sass, 2010, p. 2).

It should be noted that the term "correlation" is in reference only to a measure of linear relatedness between two variables, and as such, tells us nothing regarding a causal relation between obtaining additional education and elementary mathematics scores. A positive correlation could simply mean that those teachers that are skilled at teaching elementary mathematics tend to acquire additional forms of education compared to their colleagues. Again, keep in mind that the type of education funded through the STEM endorsement program is quite different than those types that have been the focus in much of the research literature. These differences make it inappropriate to overgeneralize the results and apply them to every form of educational attainment. For this reason, the internal and external evaluations will be the basis by which we will gauge the effectiveness of the STEM Endorsement Program. By effectiveness we mean 1) changes in student outcomes on sage scores and 2) changes in STEM teaching competency.

Update on Teacher Participation

Currently, not all of the data on teacher participation in the STEM endorsement program is available. However, we do have data from three of the seven partnerships involved in the program. Table 62 provides data regarding the number of teachers starting year 1, the number of teachers finishing year 1, and the number of those that plan on starting year 2. The ratio of those finishing year 1 and those that started year 1 is the called "Year 1 Completion Rate" and is provided in column 5.

In the future, it may be informative to investigate why there are differences in completion rates across districts. A potential factor worthy of investigation is the relationship between a teacher's distance to their partnered IHE and the probability that they will finish the first year. This has the potential of informing policy regarding the availability of online coursework or other program features that make participation less or more accessible.

University	District/Region	Started Year 1	Finished Year 1	Finishing Rate	Plan to Start Year 2
SUU	North Cohort	42	38	90.48%	38
	South Cohort	42	36	85.71%	36
	Total	**84**	**74**	**88.10%**	**74**
UVU	Provo	14	12	85.71%	11
	Park City	14	11	78.57%	10
	South Summit	4	4	100.00%	2
	Total	**32**	**27**	**84.38%**	**23**
BYU	Alpine + Nebo + Wasatch	68	52	76.47%	52

	Total	**68**	**52**	**76.47%**	**52**
Dixie	**Washington County School District**	21	16	76.19%	Data Not Available
	Total	**21**	**16**	**76.19%**	**Data Not Available**

Table 62. Completion by Partnership

Discussion

Given that both the internal and external evaluations are unavailable at this time, no recommendations regarding the STEM endorsement program are currently provided. The focus of the future evaluation will be to assess whether the STEM endorsement program was successful toward its intended aims. These aims are listed among the long term outcomes in the graphic below (Figure 71).

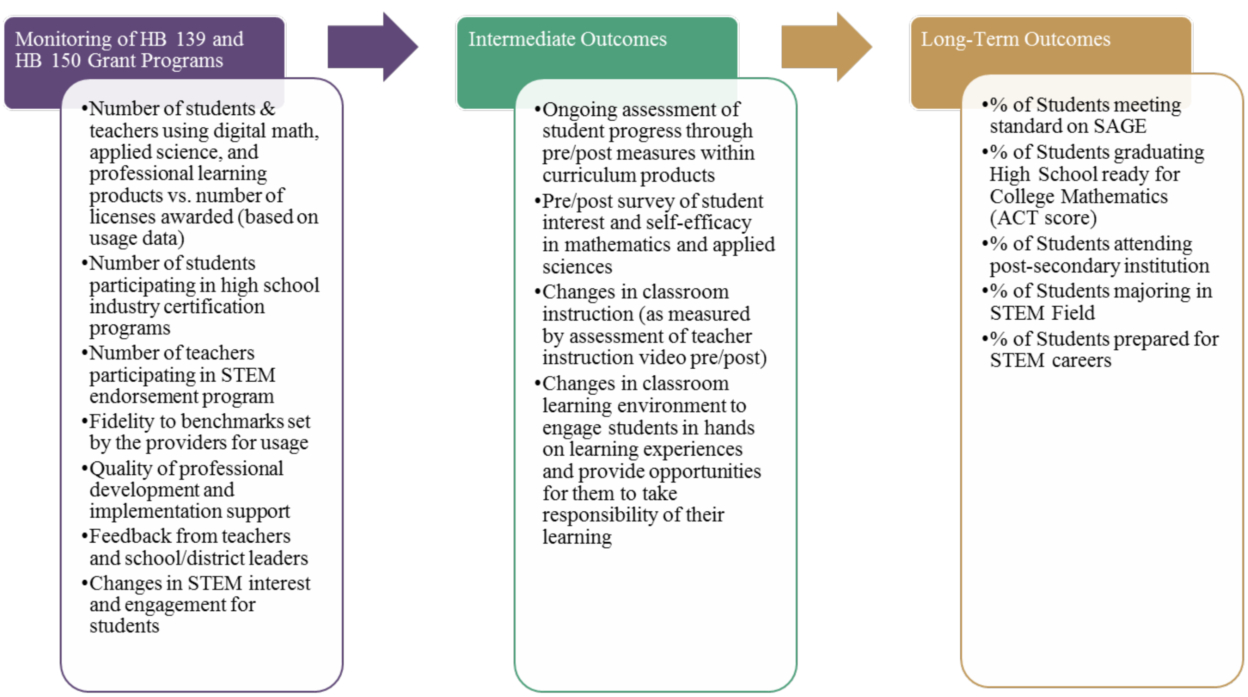


Figure 71. Intended outcomes by grant program

References

Brasiel, S., & Martin, T. (2015). *STEM Action Center Grant Program Annual Evaluation Report: 2014-15.* Department of Instructional Technology and Learning Sciences. Logan: Utah State University.

Chingos, M. M., & Peterson, P. E. (2010). *It's Easier to Pick a Good Teacher than to Train One: Familiar and New results on the Correlates of Teacher Effectiveness.* Paper prepared for A Symposium sponsored by the Economics of Education Review.

GOED. (2015). *Governor's Office of Economic Development: 2015 Annual Report and Resource Guide.* Salt Lake City, Ut: Governor's Office of Economic Development.

Gulamhussein, A. (2013). *Teaching the Teachers: Effective Professional Development in an Error of High Stakes Accountability.* National School Boards Association & Center for Public Education.

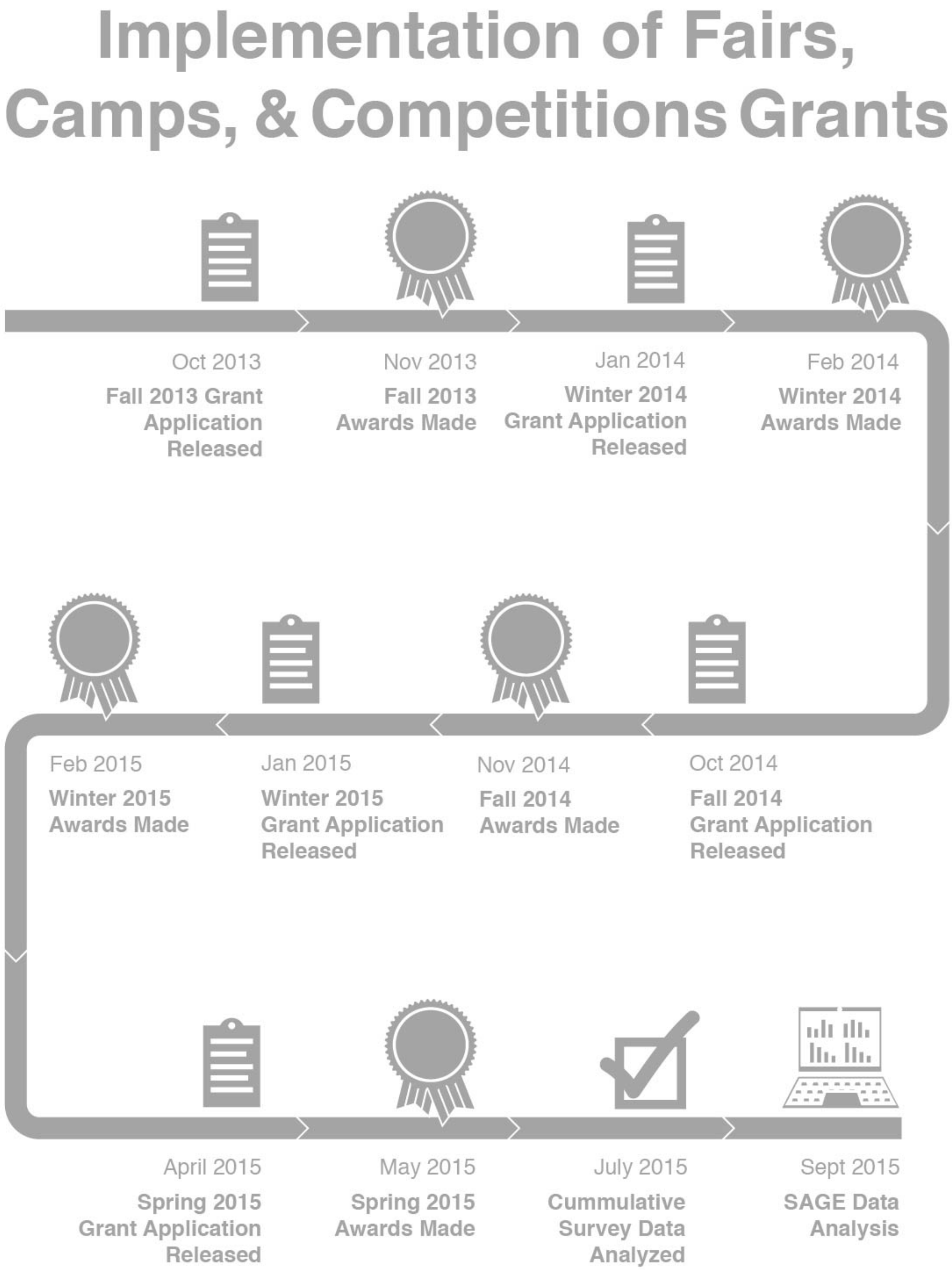
Harris, D. M., & Sass, T. R. (2010). Teacher training, teacher quality and student achievement. *Journal of Public Economics*, 798-812.

HB 150. (2014). *SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS AMENDMENTS.* Utah State Legislature.

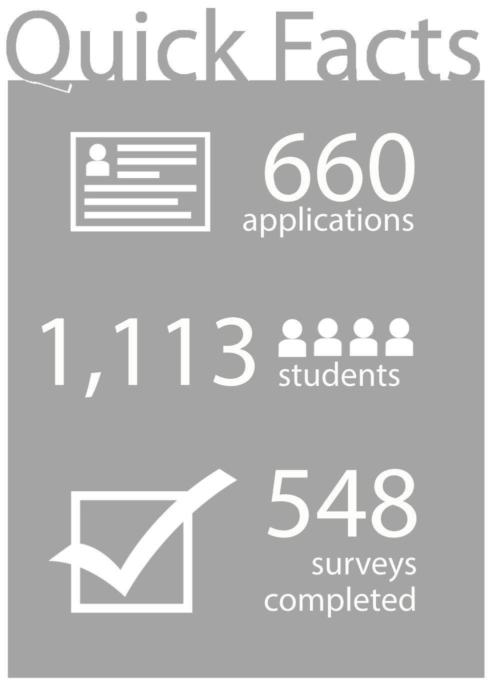
Rosen, H. S., & Gayer, T. (2013). *Public Finance.* McGraw-Hill Education.

Yoon, K. S., Duncan, T., Lee, S. W.-Y., Scarloss, B., & Shapley, K. L. (2007). *Reviewing the evidence on how teacher professional development affects student achievement.* Washington,DC: Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance.

Chapter 7 - Fairs, Camps, and Competitions Individual and Team Grants



Introduction



The Fairs, Camps, and Competitions grant program involved 1,113 students. The STEM Action Center reviewed 660 applications that included requests from individuals and teams. We administered a survey to all students who received an award. We received 548 completed surveys.

The federal government has called for an increased focus on STEM throughout the education system (The White House, Office of the Press Secretary, 2010), and seeks to ensure that there will be sufficient talent to meet industry needs; business leaders have begun partnering with schools to bring in more STEM learning experiences (Barnett, 2012 (Potvin & Hasni, 2014)). The overarching goal is to sustain economic growth by increasing *interest* in STEM fields and preparing the rising generation with the 21st century skills required to succeed in today's workforce.

Fairs, camps, and competitions (FCCs) that focus on the development of STEM skills and knowledge provide students with interdisciplinary, hands-on learning experiences, Researchers have made the claim that interest in STEM fields and 21st century skills are both cultivated through such highly engaging activities. Potvin and Hasni (2014) reviewed the literature concerning STEM FCC, and found that not only did participation positively affect interest, motivation and attitude, but also this change was positively correlated with student performance in STEM subjects. Studies have also shown that STEM interest, self-efficacy, and content knowledge can increase the rate of matriculation into stem majors (Hendricks, Alemdar, & Ogletree, 2012; Innes, Johnson, Bishop, Harvey, & Reisslein, 2012; Sahin, Gulacar & Stuessy, 2014).

Although many studies have shown an increase in STEM interest among FCC participants, it is still unclear whether the interest in STEM was a direct result of the FCC. Sahin, Gulacar, and Stuessy (2014) investigated (Thiry, Laursen, & Hunter, 2011) student perceptions of factors that have influenced their interest in STEM and STEM related careers. They found five factors to be of primary influence on their STEM interest: science teachers (31%), personal interest (24%), parents (20%), science fairs/Olympiads (11%), and the availability of jobs and related salary (5%).

The STEM Action Center awarded grants to 1,113 students who received an individual or team grant of up to $2,500. Students participated in science fairs or science projects affiliated with their school, district, or community (e.g., county science fair). Some students also participated in STEM camps throughout the state of Utah. Topics included mathematics, science, LEGOs, computer programming, and Maker activities. The competitions students participated in included both local, regional, and national competitions (e.g., FIRST LEGO League, FIRST Robotics, ECybermission, and Science Olympiad).

The overall goal for our research was to determine the influence of student participation in an array of STEM fairs, camps, and competitions. The participating students received financial support to attend or participate the events and therefore were part of a state-wide STEM education initiative. We collected data to understand what students learned from participating in a fair, camp, or competition (FCC) and to answer the following questions,

- To what extent do participants in the STEM Action Center FCC grant program have prior experience with a person who has a job in a STEM area?

- What are the career interests of students attending FCC?
- What did students learn from participating in a fair, camp, or competition with a STEM focus?
- How do students plan to share what they learned with others?

Fairs, Camps, and Competition Implementation

The STEM Action Center began the fairs, camps, and competitions grant program in October 2013 with the release of the first application announcement (as shown in Figure 6). During the 2015-2016 academic year, there were two rounds of awards made, fall and winter. All students had to turn in receipts by June 2015, which was the deadline for the STEM Action Center to provide them payment for their award. During the 2015-2016 academic year there were three grant periods (fall, winter, and spring), and again students had to submit their receipts by June 2015 to receive payment for their award. Prior to receiving their award, the students completed a survey for the purposes of this grant program evaluation.

The STEM Action Center awarded grants to 1,113 individual or team grant of up to $2,500. Students participated in science fairs or science projects affiliated with their school, district or large community (e.g., county science fair). The STEM camps that students participated in were restricted to camps within the state; many of these were about mathematics, science, LEGOs, computer programming, and Maker activities. The competitions students participated in included both local, regional, and national competitions (e.g., FIRSTLEGO League, FIRST Robotics, ECybermission, and Science Olympiad).

Data Collection and Analysis

Fairs, Camps, and Competition Participation Survey

A qualitative research approach was used to collect data about student perceptions through a survey with four open-ended questions. The STEM Action Center sent each of the

1,113 students who received a grant to attend an FCC a link to the survey with a requirement to complete the survey prior to receiving their grant. We received data from 548 students who completed the survey. Of those completing the surveys, 16% were elementary level students, 23% were middle school or junior high school students, 30% were at the high school level. Charter school students comprised of 23% of the responses, 5% were private students, and the remaining 3% were home schooled students.

The participating students received funding to engage in science fairs or science projects affiliated with their school, district or local community (e.g., county science fair). The STEM camps that students participated in were related to mathematics, science, LEGOs, computer programming, and makerspace activities. The competitions students participated in included local, regional, and national competitions (e.g., FIRST LEGO League, FIRST Robotics, ECybermission, Science Olympiad). A full list of the events that we included in the evaluation are presented in Table 63.

Fairs	Camps	Competitions
Science Fair	Teton Science School	FIRST Lego League
Science and Engineering Fair	Lego Camp	FIRST Robotics
Intel International Science and Engineering Fair	Math Camp	VEX Robotics
	4H Maker Camp	Girls go Digital
	BYU Programming	American Regional Mathematics League
	SUU TECS Summer Camp	TSA National
	DSU Tech Camp	Create USA Open Robotics
	Galaxy Camp	FTC Regional
	Mad Science Secret Agent Lab	FIRST Technology Challenge
	Dixie State University Tech Camp	Team America Rocketry Challenge
	Mad Science of Greater Salt Lake: Junior Engineers	AFRL Grant Challenge National
	Discovery Space Center	Academic Decathlon

	Ultimate Camp	
	FLL Camp	Fairfield Challenge and Envirothon
	AstroCamp	Utah ROV
		American Regions Math League
		Science/Math Olympiad

Table 63. Fairs, Camps, and Competitions

Fairs, Camps, and Competition Participation Survey

While such experiences appear to be effective at promoting participant's development and interest, many students are unable to afford participation. We investigated student perceptions of the effects of grants to participate in FCCs across a statewide initiative to increase student interest and learning in STEM related subjects. This is particularly important considering that, though these grants were awarded to individuals or teams, the grants were intended to produce statewide effects.

We open-coded the student responses to understand some of the key response categories and themes related to the research questions (Strauss & Corbin, 1998). For each of the four survey items we provide tables summarizing the greatest percent of student response categories. These data are found in the results section of this report.

Results

The Fairs, Camps, and Competitions grant program involved 1,113 students. The STEM Action Center reviewed 660 applications that included requests from individuals and teams. We administered a survey to all students who received an award. We received 548 completed surveys. Students reported on what they learned a how they plan to share what they learned with others.

The STEM Action Center asked students who received an award from the STEM Action

Center to cover part of the cost of a fair, camp, or competition (FCC) to complete a survey after they attended the event and prior to receiving their grant award. We received completed surveys from 548 students. For each of the four survey items, we provide tables summarizing the greatest percent of student response categories. It is important to note, the percentages do not always add to 100 percent, as students at times mention two or more categories in their responses, or fail to answer the question.

Knowledge of Someone in a STEM Career

For the first question on the survey, we asked students to tell about someone they know that works in a STEM career and what they know about that job. Five percent of the students did not know someone in a STEM career. In Table 64, we provide the gender and relationship of the individual students referenced, which might be important for future research.

Category (N =548)	Percentage
Male Relative (N = 273)	49%
Female Relative (N = 21)	4%
Female and Male Relatives in STEM (N = 13)	2%
Male Teacher (N = 14)	3%
Female Teacher (N = 18)	3%
Male Acquaintance (N = 86)	16%
Female Acquaintance (N = 2)	.004%
Male Mentor/coach (N = 10)	2%
Female Mentor/coach (N = 5)	1%
Gender unknown teacher (N = 8)	1%
Gender unknown Acquaintance (N = 28)	5%
Gender unknown relatives (N = 2)	.004%
Unknown Gender Mentor/Coach (N = 22)	4%

Don't know anyone in STEM (N = 34)	6%

Table 64. Gender and Relationship of Person in STEM Career (N= 548)

As is shown by student responses to this first survey question, the majority of students know a person in a STEM Career who is either a male relative or a male acquaintance. Results suggest 70% of students surveyed knew or were inspired by a male in a STEM career; whereas, only 8% indicated they knew or where inspired by a female in the STEM industry. As one goal is to encourage females to pursue STEM Careers, perhaps additional effort is needed in the state to expose students to females who are also in STEM Careers.

This is a noteworthy finding, and as a result, we also examined these responses more closely hoping to identify the source of their interest. Of the 548 respondents who expressed interest in a STEM career, 95 percent indicated that their career interest stemmed from their interactions with parents, teachers, mentors, or STEM professionals. The remaining five percent indicated they did not know anyone in STEM industry. These findings are not drastically different from the findings of prior research by Sahin, Gulacar, and Stuessy (2014).

Career Interests

The second survey question asked students about their career interests. We placed their responses in one of the following categories shown in Table 65.

Category Percent (N = 548)	
Engineering (N = 170)	31%
Technology/Computers (N =90)	16%
Medical (N = 73)	13%
General careers in Science or Mathematics (N = 55)	10%

Miscellaneous Career Fields (N= 50)	9%
Design/Architecture (N = 32)	6%
Teaching (N = 24)	4%
Unsure (N = 22)	4%
Business (N = 14)	3%
Space Sciences (N = 9)	2%
Aviation (N = 8)	1%

Table 65

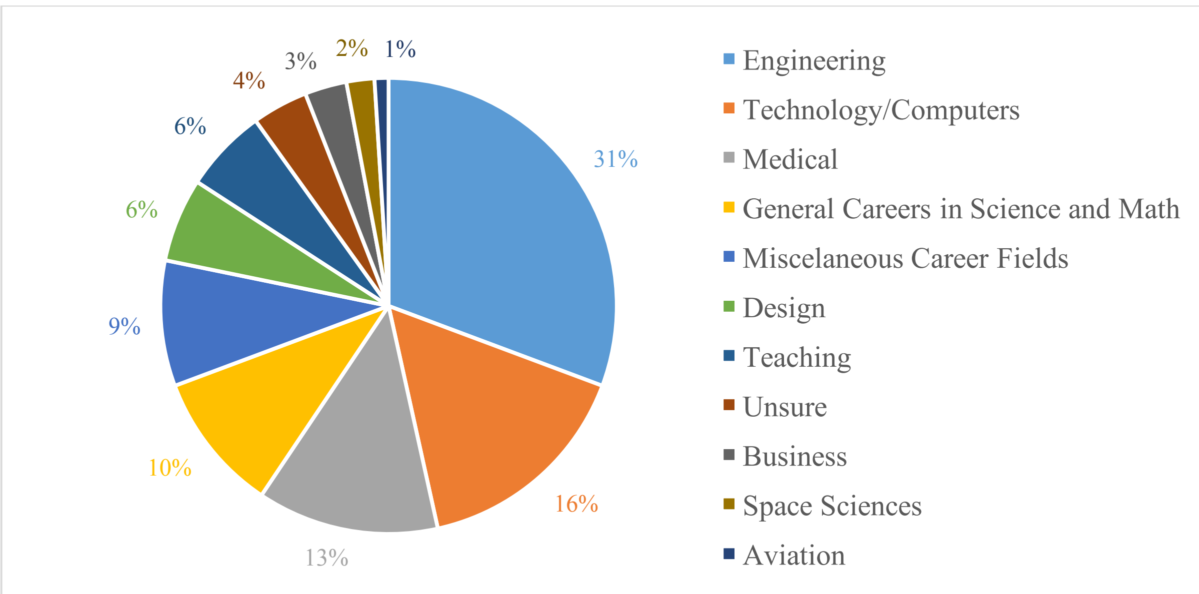


Figure 72. Most Common Student Responses about Future Career Interests (N = 547)

As shown by student responses in Table 65, Figure 72, approximately 31% percent of the students mentioned engineering related careers, followed by technology or computer programming (16%), followed the medical field (13%) and general careers in science and math career fields (10%).

Learning from Participation

We also asked students to discuss what they learned through participation in the FCCs. In Table 66, we summarize the categories of students' responses.

STEM Content Area /Skill Category (N = 548)	Percent	Student Response
Robotics (N = 131)	**24%**	*"I learned how to program, design and build an EV3 robot so it could best complete our challenges. I also improved how to speak in public. "*
Collaboration and Teamwork (N = 130)	**24%**	*"I learned gracious professionalism, safety, and strategy. I saw others' designs and concepts, and it was great for me to learn how when people are given the same problem, they usually come up with more than one solution. we can blend all these solutions together, and you make your own solution better because of it."*
General Science (N =110)	**20%**	*"I learned about anatomy and physiology, biology, and geographic mapping."*
Computer Programming/Technology (N = 48)	**9%**	*"I learned about coding, hacking, games, and building websites. I learned quite a bit of stuff that I never knew before and I did enjoy going to the camp."*
Engineering (N = 44)	**8%**	*"Throughout the competition I have learned many things from sportsmanship a few fields of engineering. The competition helps teach computer programming, mechanical engineering, and electrical engineering."*
Mathematics (N = 25)	**5%**	*"I learned lots of geometry. Similar triangles, Power of a point, Congruence, Similarity, Shapes inscribed in another, some 3D geometry, and more."*

Environmental Science (N = 16)	**3%**	*"I learned about the environment in Zions national park, as well as some of the environmental challenges facing our state today, and I learned how to look at an environmental problem and figure out a solution to it, while working as a team."*
Space Sciences (N = 11)	**2%**	*"We learned more about black holes, the nebula, ort clouds, and satellites in space. We learned how to work as a team. We learned how to control different jobs. We learned how to do space missions."*
Physics (N = 6)	**1%**	*"We learned more about black holes, the nebula, ort clouds, and satellites in space. We learned how to work as a team. We learned how to control different jobs. We learned how to do space missions. "*
Chemistry (N = 5)	**1%**	*"I learned more about chemistry, including molarity, pH value, Ka value, and dissociable hydrogen atoms. I learned that Ka has a negative association with curd thickness in casein plastic. I learned more about statistical analysis and scientific conclusions."*
N/A (N = 5)	**1%**	

Table 66. Student Responses about Content or Concepts Learned at FCC (N= 548)

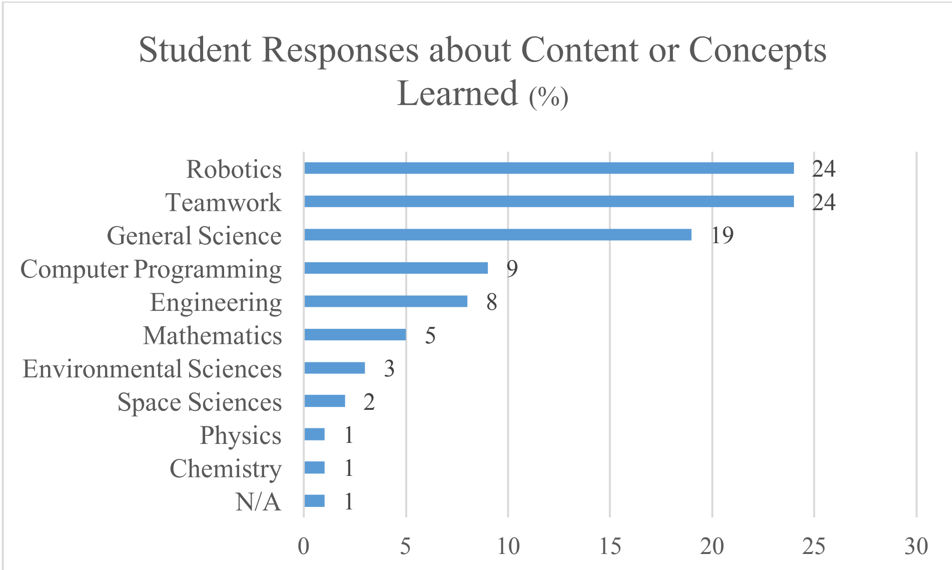


Figure 73. Student Responses about Content or Concepts Learned at FCCs (N = 548)

As shown by student responses in Table 66, Figure 73, approximately 24 percent of the students surveyed stated the most common content or concept learned was Robotics, followed by general science (19%), followed by technology or computer programing (9%), engineering (8%), mathematics (5%), space sciences (2%), chemistry (1%), and finally, not applicable (1%).

It is important to note that the second most common response was teamwork and collaboration (24%). While cooperative learning has been used for over two decades (Slavin, 1990), it may be less common for students in schools, which may be why this feature of the program stood out for students. Students not only had the opportunity to engage in inquiry, but also to collaborate and solve problems with other students. As one student mentioned,

> *At first it seemed easy, but I learned that it is harder than it looks to write a program to move the objects and use the program to complete missions. A team can be a challenge to work with, but everyone can benefit the team to solve problems.*

Sharing What They Learned

The final survey item (see Table 67) asked students to discuss their plans to share what they learned.

Category	Sample Response	Percent
General Sharing (N = 190)	*"By actively sharing my experiences, I can cultivate a passion for learning and teamwork in those who may not realize what opportunities are available to."*	35%
Sharing and teaching peers and family (N = 80)	*I will teach my family binary codes and I will have them make pixel art."*	15%
Mentoring other students (N = 66)	*"My team works with four other FLL teams and I have gotten to know other kids at the qualifiers that we talk with. Currently, we volunteer to mentor six Jr. FLL teams that will be participating in our school's Science and Engineering Fair. Some of the members of our team have been chosen to judge the Jr. FLL portion of this fair. I hope that I can help these teams have a good experience and learn to love engineering just like I did."*	12%
Recruiting (N = 50)	*"I did not see another student from my high school (Riverton High). I plan on talking to Riverton's chemistry teachers (who nominate students to participate), especially Ms. Rossiter, the AP chemistry teacher. I will highly recommend to any student considering taking AP chemistry to take this course during the summer to gain credit hours and experience before beginning the formal high school course. I will also talk to my school counselors to push chemistry teachers to nominate students."*	9%
Competing again in the future (N = 32)	*"I plan on participating in the Academic Decathlon competition next year so I can translate the knowledge and skills I've acquired to communication with my fellow members."*	6%
Technology or Social Media (N = 24)	*"My team posted this information on YouTube so the whole world can know this."*	4%
Share with community or government officials (N = 19)	*"We presented our recycling ideas to the mayor. She wants us to present them to the city council."*	3%
Through future career/endeavors (N = 15)	*"I can apply the information that I have learned to my general academic experience and further to my STEM focused career as I plan to go to college and join a career in science or mathematics. I can use the speaking skills I've gained to advocate an understanding of science among my peers and the public as I have learned that science can be an integral aspect*	3%

	in the solutions of the future."	
Start a club, team or organization (N = 12)	*"I have started a class in my basement where I teach other kids (younger than me) from the neighborhood. I teach them about robotics and programming. They enjoy to learn and without having to buy the kit. I love to learn more to teach them."*	2%
Share with School (N = 11)	*"We shared our research idea and prototype with Alpine School District and received really good feedback with which to improve our project."*	2%
Volunteer/Service (N = 6)	*"I am planning to volunteer at the Discovery Space Center so I can help others have similar experiences."*	1%
Unsure/Don't plan on sharing (N = 6)	*"I do not plan to share anything I have learned this year with others."*	1%

Table 67. Student Responses for How They Will Share What They Have Learned (N =548)

Based on the responses to the final question, 47 percent of respondents indicated a desire to share their experiences in general, with family, or with peers. An additional 9 percent of respondents reported a desire to mentor younger students or attempt to get other students interested in participating in the future. These findings are noteworthy, as prior research has shown that sharing, mentoring, and teaching others what they learned has the potential to increase STEM content knowledge and develop skills essential for success in the emerging job market (Thiry, Laursen, & Hunter, 2011).

The impact of this small grant was often exceptional. For example, two students used this grant to devise a way to power Hydrogen fuel cells using Aluminum and Sodium Hydroxide. They won an award from the American Institute of Aeronautics and Astronautics, and took first in their competition, advancing to the Intel International Science and Engineering Fair in L.A. Equipped with these findings, policymakers gain a clearer perspective of how grants funding FCCs contribute to overall STEM efforts, and demonstrates the impact these experiences can have on student's future interest and career choices.

SAGE Assessment Results

An analysis of participating FCC students' SAGE assessment results was not completed at this time. There are two reasons why SAGE analysis has been postponed. First, the sample of students was not large enough to be representative of any demographic, thus it would be an invalid measure when comparing the results to students' who did not participate in a fair camp or competition. Second, there is not available measure to determine the level at which participating students engaged in their program. Thus, confounding the comparison of students who participated in FCC versus those who did not.

Recommendations

A majority of the participating students reported a reinforced desire to pursue STEM careers and improvement in understanding and skills related to STEM. Our analysis of the students' responses regarding knowing a STEM professional revealed the majority of the participants knew a male STEM professional. Given the evidence suggesting that there is a relationship between interest in STEM and knowing a STEM professional (Sahin et al., 2014 (Beilock, Gunderson, Ramirez, & Levine, 2010)), there may be justification for engaging students with STEM professionals often and early in their education. Further, the predominance of males in the students' responses suggest that there is a need to assure students are also exposed to female STEM professionals. The exposure to female role models is even more important to girls given the association to their potential performance in STEM learning (Beilock et al., 2010). Gaining a deeper understanding about how student engagement in STEM activities outside of school, particularly girls, might be influenced by the role models they work with is an excellent direction for future research.

We also found that the vast majority of the FCC participants indicated intentions to pursue a STEM career. Many of the competitions focused on engineering, and thus could explain the participants' interest in pursuing an engineering related degree. However, there was not a corresponding association between FCC focused computer science events and the much larger percentage of participants indicating interest in a career in computer science. We speculate that a combination of factors such as those discussed previously (Sahin et al., 2014) are likely to influence student interest and possibly consideration of STEM careers regardless of their extracurricular activities.

As we examined participants' learning STEM content and technical skills, we found the large emphasis on learning engineering and computing skills is likely due to the technical content focused on in FCCs related to robotics and similar activities. The remaining STEM skills and concepts learned are aligned with the foci of other FCC activities, which suggests that the students did learn more about STEM from their participation. It is interesting to note that the most common response overall was the 21st century skill of collaboration (34%). Our findings are aligned with the outcomes of prior research about FCC influence on participants' learning of teamwork, problem solving, and communication skills (Bruin, Rikers, & Schmidt, 2007; Chi, Bassok, Lewis, Reimann, & Glaser; Chi, Leeuw, Chiu, & LaVancher, 1994; Yilmaz et al., 2010).

Our final area of investigation focused on the students' plans to share what they learned with others. The fact that many of the participants reported plans to share with other students or siblings suggests that formally preparing the participants to share what they learned with others is likely to be a very effective method of FCC promotion. Numerous studies show that the generation of self-explanations (a process which is essential to effectively teaching and sharing with others) improves problem solving, retention, and knowledge transfer (Chi et al., 1989; Chi et al., 1994; de Bruin, Rikers, & Schmidt, 2007). The eagerness and diversity of ways the participants indicated that they were willing to share suggests that they developed ownership of their learning. Exploring the relationship between levels of learning ownership and desire to share learning associated with FCCs is an excellent direction for future research.

Recommendations

A challenge is our constraint of working exclusively with post FCC data, and not being able to compare the students' pre-conceptions to their post event learning. Further, the lack of pre-data limits our ability to determine how much the students actually learned from the camp beyond what they reported. However, the students did report learning from the events, and given that our research was across multiple FCC events, we needed to maintain a generalized approach to data collection, focusing on the common experiences of the students across FCC events. Perhaps in the future, pre and post FCC event data can be gathered to determine if we can effectively capture changes in students' knowledge and perceptions. Moreover, incorporating a grant management software, with the ability to track student enrollment and exit from the grant program, would help us to clearly document the number of students served.

As this is the last year of FCC, we would recommend consideration of FCC in the future. Students expressed enthusiasm towards STEM and clearly expressed excitement about their experiences and the specific content they learned. The FCC provides students with a collaborative, inquiry-based opportunities targeted at individual student's areas of interest. It also affords collaborative, inquiry-based opportunities which are not always offered in typical classroom environments. As one student stated,

> *"All of us learned many different things, but the main thing we learned, is the true meaning of Fellowship. In the beginning we were not very close, but now things have changed dramatically in many ways. Our relationship is stronger than*

ever. Without the F.L.L. Competition, we would be nowhere in our relationships. We were also able to learn how to draw engineering diagrams, create blue prints, and go to a machine shop to build a real working prototype of our project. That was a great experience!"

References

Barnett, M. (n.d.). *Spotlight on a STEM school.* Principal, 8, 9.

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceddings of the National Academy of Sciences, 107*(5), 1860-1863.

Bruin, A. B., Rikers, R. M., & Schmidt, H. G. (2007). The effect of self-explanation and prediction on the development of principled understanding of chess in novices. *Contemporary Education Psychology, 32*(2), 188-205.

Chi, M. T., Bassok, M., Lewis, M. W., Reimann, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13*(2), 145-182.

Chi, M. T., Leeuw, N., Chiu, M. H., & LaVancher, C. (1994). Eliciting self-explanations improves understanding. *Cognitive Science, 18*(3), 439-477.

Hendricks, C. C., Alemdar, M., & Ogletree, T. (2012). The impact of participation in VEX robotics competition on middle and high school students' interest in pursuing STEM studies and STEM-related careers. *Proceddings of the American Society for Engineering Education annual conference and exposition*.

Innes, T., Johnson, A. M., Bishop, K. L., Harvey, J., & Reisslein, M. (2012). The Arizona Science Lab (ASL): Fieldtrip based STEM outreach with a full engineering design, build, and test cycle. *Global Journal of Engineering Education, 14*(3), 225-232.

Melchior, A., Cutter, T., & Deshpande, A. (n.d.). *Evaluation of the FIRST LEGO League "Climate Connections" season (2008-2009).* Brandeis University Center for Youth and Communities, Waltham, MA.

Potvin, P., & Hasni, A. (2014). Interest, motivation and attitude towards science and technology at K-12 levels: a systematic review of 12 years of educational research. *Studies in Science Education, 50*(1), 85-129.

Sahin, A. (2013). STEM clubs and science fair competitions: Effects on post-secondary matriculation. *Journal of STEM Education: Innovations and Research, 14*(1), 5-11.

Sahin, A., Gulacar, O., & Stuessy, C. (2014). High school students' preceptions of the effects of international science olympiad on their STEM career aspirations and twenty-first century skill development. *Research in Science Education*, 1-21.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Procedures and techniques for developing grounded theory.* Thousand Oaks, CA: Sage.

The White House, Office of the Press Secretary. (2010). *President Obama to announce major expansion of "educate to innovate" campaign to improve science, technology, engineering and math (STEM) education [Press release]*. Retrieved from Whitehouse.gov: https://www.whitehouse.gov/the-press-office/2010/09/16/president-Obama-announce-major-expansion-educate-innovate-campaign-impro

Thiry, H., Laursen, S. L., & Hunter, A. B. (2011). What experiences help students become scientists? A comparitive study of research and other sources of personal and professional gains for STEM undergraduates. *The Journal of Higher Education, 82*(4), 357-388.

Yilmaz, M. K., Ren, J., Custer, S., & Coleman, J. (2010). Hands-on summer camp to attract K-12 students to engineering fields. *IEEE Transactions On Education, 53*(1), 144-151.

Appendix A – K-12 SAGE Analysis

Methods

This Appendix provides an analysis of the associations between students' SAGE scores and the STEM AC funded mathematics software. For information on each of the STEM AC funded software products, see Appendix B. For information regarding students and teacher's perceptions and software usage see Chapter 2 of the main report.

SAGE data from participating students and non-participating students was collected and treatment and comparison groups were formed using propensity score matching. After suitable comparison groups were formed, a logistic regression was completed to determine any associations between software use and students' SAGE assessment scores. Due to low response rates from requests for student state identification (SSID) data, approximately one-third of participating students SAGE scores were included in this analysis.

Of the 166,993 software licenses distributed, 49,891 unique SSIDs were submitted by participating local education agencies (LEAs). After removing students who requested to be excluded from the research study, we merged these SSIDs with student software usage data. These data were then submitted to the Utah State Board of Education (USBE) to be merged with students' SAGE scores. The USBE then identified problematic SSIDs and replaced these with corrected values. This resulted in a final de-identified data set containing SAGE scores and demographic data for 370,236 students, of which approximately 47,000 used STEM AC funded software. Some students were excluded because they did not take a SAGE assessment during the 2015-16 academic year. There are several reasons that students may not take a SAGE assessment which include: opting out, the student is in grades K-3, or the student has already taken all SAGE assessments.

Software distribution was not controlled by the researchers in any of the comparison groups, i.e., this is an observational research study. These types of data require methodologies designed to construct quasi-experimental control groups, or comparison groups. To this end, propensity score matching was used to form comparison groups from both STEM AC funded and unfunded students in the SAGE assessment data. This method matches students in the treatment group with students outside the treatment group, using a set of confounding factors as covariates. In particular, some combination of the following was used to construct the comparison groups in this study: socioeconomic status (SES), special education (SPED) status, English language learner status (ELL), race, gender, and previous year's SAGE assessment proficiency scores. Matching in this way, controls only for those confounding variables contained in the method. To increase the number of matches, some of these variables were excluded in certain subgroups. In some cases, a suitable match could not be found due to small sample size or divergence of the method. These data were excluded from this analysis.

After forming comparison groups via propensity score matching, a logistic regression was computed comparing three different groups of students: High fidelity (those students who exceeded the vendor defined fidelity benchmark), low fidelity (those students with some usage below the fidelity benchmark), and students who were not funded by the STEM AC. Each of these groups of students were compared pairwise. The same covariates used in the matching procedure were used as control variables in the logistic regression. In this addendum, we focus on the key results of the three pairwise compared groups in the SAGE mathematics domain. These include reporting the: odds ratio (effect size), standardized difference in means (standardized effect size), and the standard error, *p*-value, and 95 percent confidence interval for all effect sizes. We also include the sample sizes and average product usage for all groups and the proportions for demographics for STEM AC funded students.

Comparison Group Usage Summaries

Tables 68, 69, and 70 provide a summary of sample sizes and average usage for each of the three comparison groups: high fidelity (HF) vs unfunded (UF), HF vs low fidelity (LF), and LF vs UF. Vendors provided usage data in a variety of formats including usage in minutes, days, lessons completed, etc. (see Chapter 2 for detailed information regarding software usage). Where appropriate, these have been converted to usage in minutes, with the exception of ST Math, who did not provide any usage data in units of time and for whom no data was available for usage conversion to minutes. Thus, this measure has been excluded. Usage statistics have also been excluded for the unfunded students, given that these data were unavailable.

Each vendor set their own fidelity level, which is a benchmark, or threshold, in units of time or lessons or a combination of both. A student passing this threshold, is considered to have used the product with fidelity. The comparison groups have been defined by this threshold. High fidelity are those students who have passed the threshold, while low fidelity are those students who have not. Unfunded students are those students for whom we received SAGE data from the USBE, but did not receive STEM AC funded software, though they may have used software purchased separately by their local education agency (LEA).

The STEM AC funded nine mathematics software products including: ALEKS, Catch Up Math, EdReady, iReady, Math XL, Reflex Math, ST Math, Successmaker, and Think Through Math. Of these nine products, 5 had large enough samples to be included in each of the comparison groups. These were ALEKS, Think Through Math, iReady, ST Math, and Reflex Math. Successmaker had a large enough sample to be included in the HF vs UF group and Catch Up Math had a large enough sample to be included in the LF vs UF group. For nearly every product, the standard deviation of the average minutes of use was large in comparison to the mean. Thus, the variation in the amount of time that students spent using the software was large, with users spanning the range from low to high use. Usage mean and standard deviation is not available for the unfunded comparison group.

High Fidelity Users (T) Compared to Low Fidelity (C): Summary Statistics						
Product	**Sample Size T**	**Sample Size C**	**Usage T Mean**	**Usage T SD**	**Usage C Mean**	**Usage C SD**
ALEKS	10058	10058	36.695	26.375	8.578	6.639
Think Through Math	1893	1893	2134.255	1281.344	441.68	501.999
iReady	947	947	1756.964	513.09	758.582	292.917
ST Math	1199	1199	Data Unavailable		Data Unavailable	
Reflex Math	293	293	416.519	233.223	76.792	69.789

Table 68. This table gives the sample size, average usage, and standard deviation of average software use for the propensity score matched sample, which were used to compare SAGE results for students with high fidelity software use to students with low fidelity use. Since both sets of students were funded by the STEM AC, usage data was available for both groups.

A comparison of students' demographic characteristics between the full SAGE assessment data and the analytic sample resulting from propensity score matching is contained in Appendix F. Table 71 is an example of this comparison for the software product, ALEKS. The row names in these tables are the covariates for which a subset was used in both the propensity score matching and logistic regression procedures. The entries within the tables are the proportions for each demographic characteristic, and are given for treatment (T) and comparison (C) groups for each of the comparisons made in this report (i.e., HF vs. UF, HF vs. LF, and LF vs. UF). The T and C columns give the proportions from the full SAGE assessment data set and the "Matched T" and "Matched C" columns give the proportions for the propensity score matched sample. Although there was some variation in demographics between the entire SAGE data set and the matched set, most matches were comparable.

Aleks												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	37.98%	35.50%	32.70%	36.70%	37.98%	48.60%	48.10%	31.80%	48.60%	35.50%	37.90%	47.30%
SPED	8.65%	12.42%	9.50%	8.30%	8.65%	15.10%	14.00%	4.50%	15.10%	12.42%	14.00%	14.80%
ELL	3.13%	4.53%	3.00%	2.50%	3.13%	6.00%	5.10%	1.10%	6.00%	4.53%	4.60%	4.80%
White	78.79%	74.83%	77.00%	79.90%	78.79%	71.70%	70.90%	85.30%	71.70%	74.83%	73.40%	73.20%
Hispanic	15.14%	16.82%	15.30%	14.30%	15.14%	20.00%	21.70%	10.00%	20.00%	16.82%	18.00%	19.80%
Male	48.63%	51.55%	51.40%	48.50%	48.63%	53.40%	53.80%	48.50%	53.40%	51.55%	51.80%	53.40%
Proficient ELA	49.97%	45.61%	49.60%	50.70%	49.97%	36.22%	35.60%	66.30%	36.22%	45.61%	39.50%	36.90%
Proficient Math	49.52%	46.07%	50.40%	50.40%	49.52%	36.93%	36.10%	73.40%	36.93%	46.07%	37.90%	37.90%

Table 69. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups.

Logistic Regression and Effect Sizes

A logistic regression provides, as an output, the logged odds of the dependent variable, which can be converted into an odds ratio via exponentiation. The odds ratio is often used to interpret the results of a logistic regression, and is often used as an effect size due to its intuitive interpretation. In this report, the odds ratio is the odds of proficiency given a specified level of software use, divided by the odds of proficiency given software use at a different level, possibly including no software use at all. For example, suppose that, for product x, we computed a logistic regression for the comparison group high fidelity (HF) vs unfunded (UF). The odds ratio in this case is the odds of proficiency given HF software use divided by the odds of proficiency given no funding from the STEM AC. Suppose that we obtained 1.3 as an odds ratio. Then the odds of proficiency are 30%, or 1.3 times, higher for students with HF software use than their unfunded peers. On the other hand, suppose that we obtained 0.75 as an odds ratio. Then the odds of proficiency for a student who used the software with HF is 75% of the odds that an unfunded student will be proficient. An easier way to interpret an odds ratio less than 1 is to take its reciprocal. This value is the odds of proficiency in the unfunded group compared to the students with HF, i.e., the odds of proficiency for an unfunded student are 1/.75 = 1.333 times greater than a student who had HF. More simply, in this context, anything greater than 1.0 favors the STEM AC funded students, and anything less than 1.0 favors the unfunded students.

While the odds ratio is helpful in interpreting the effect of a treatment, it is possible to have odds ratios that are not statistically significant. Therefore, we include the p-value, which is a measure of statistical significance. This evaluation study uses a .05 threshold for statistical significance, that is, p-values less than .05 are considered significant. To illustrate this, consider again the odds ratio of 1.3. If we had found a p-value of .23, then this odds ratio would not be statistically significant at the .95 level. On the other hand, if we obtained a p-value of .01, then we would consider this result to be statistically significant, again at the .95 level.

To assist in further research, we have included the standardized difference in mean. This is a standardized effect size specifically designed to be used in meta-analysis. We note here that, though common, the Cox transformation was not used to derive these standardized effect size, rather, the logged odds were divided by $\frac{\pi}{\sqrt{3}}$, or 1.81. This value is the standard deviation for the logged odds distribution.

In addition to considering the p-values, the significance of statistical finding is also dependent upon the control variables used in the logistic regression. As mentioned previously, demographic data including: previous year's ELA and math SAGE scores, race, gender, ELL, SES, and SPED status were used as control variable for each comparison group.

Figure 74 and Table 72 display the odds ratios for STEM AC funded students with high fidelity (HF) vs unfunded student (UF). Three software products (ALEKS, ST Math, and Think Through Math) had statistically significant odds ratios; these are colored in teal. Those products that did not have statistically significant results are colored light red. We follow this color convention for each of the following plots. When comparing STEM AC funded users in the HF group to their unfunded peers, the odds of proficiency for ALEKS HF users were about 19% higher than their unfunded peers, with confidence interval, C.I.: (1.026, 1.379), HF ST Math users' odds were 52% higher, with C.I.: (1.045, 2.207), and HF Think Through Math users' odds of proficiency were 3 times their unfunded peers, with C.I.: (2.016, 4.717).

The confidence intervals have been included. Note that these are inversely proportional to the $\sqrt{n}$, where n is the sample size. Thus, you would expect large samples to have small confidence intervals, which we see below in the case of ALEKS, whose sample size was double or more compared to the other products. Further, the size of a confidence interval is a measure of the accuracy of the statistic (the odds ratio in this case), since, given a set of data, each odds ratio computed from a sample from the data will be covered by the confidence interval about 95% of the time. Thus, a larger confidence interval results in a larger range for the samples odds ratio. For example, consider Think Through Math from Table 72 below. The range of possible values for the odds ratio is 2.016 to 4.717. Thus, we expect the actual odds ratio to be covered by this interval 95% of the time.

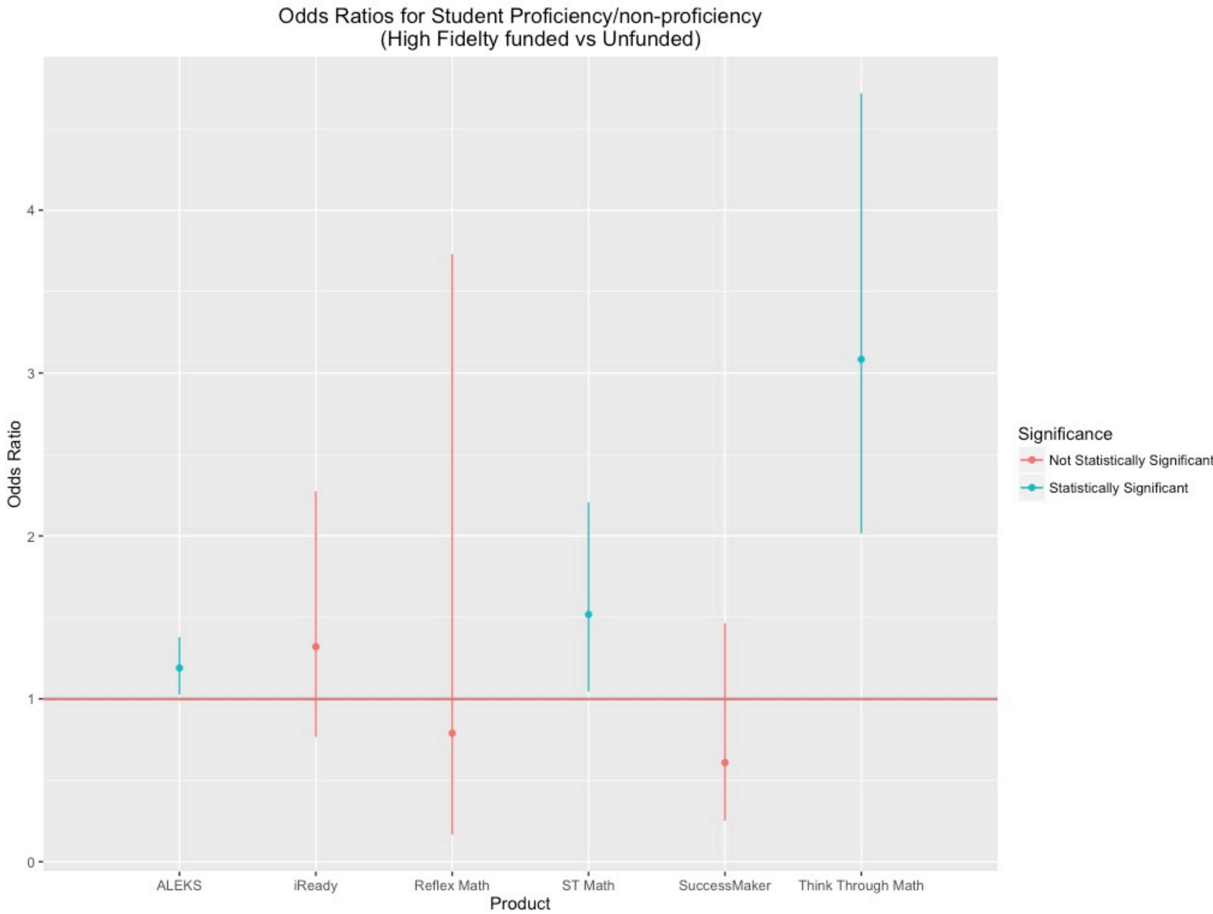


Figure 74. This plot shows the odds ratios with their accompanying .95 confidence intervals resulting from the logistic regression comparing high fidelity users with their unfunded counterparts. Statistically significant results were colored in teal.

High Fidelity Users Compared with Non STEM AC Funded Students: **Odds Ratio**						
Product	**Odds Ratio (effect size)**	**Standard Error**	**CI Lower Limit**	**CI Upper Limit**	**p-Value**	**Sample Size**
ALEKS	1.189	0.042	1.026	1.379	0.022	16268
Think Through Math	3.084	0.120	2.016	4.717	0.000	1893
iReady	1.32	0.153	0.766	2.275	0.317	947

ST Math	1.518	0.105	1.045	2.207	0.029	1199
Reflex Math	0.789	0.437	0.167	3.731	0.765	418
SuccessMaker	0.608	0.247	0.252	1.464	0.268	279

Table 70. These data are the key results from the logistic regression comparing HF users to their unfunded counterparts.

Table 73 and Figure 75 below display the odds ratios resulting from the logistic regression comparing STEM AC funded students with high fidelity (HF) vs STEM AC funded students with low fidelity (LF). Two products showed statistically significant odds ratios; ALEKS and Think Through Math. For ALEKS, HF students' odds of proficiency were 74% greater than their LF peers, with C.I.: (1.462, 2.064). The odds of proficiency for Think Through Math students who had HF were about 2.5 time greater than their LF peers, with C.I.: (1.635, 3.559).

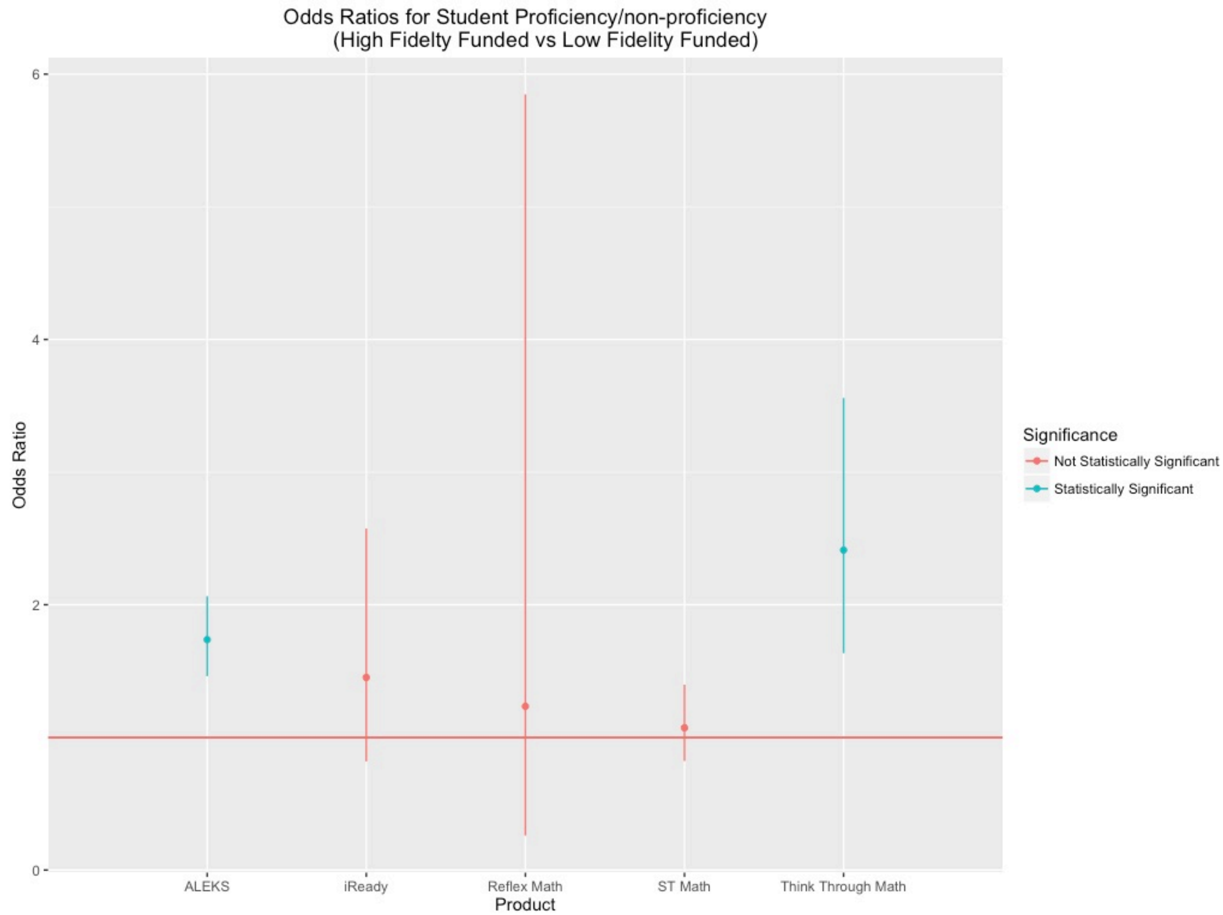


Figure 75. This plot shows the odds ratios with their accompanying .95 confidence intervals resulting from the logistic regression comparing students with high fidelity software use to those with low fidelity. Statistically significant results were colored in teal

High Fidelity User Compared to Low Fidelity Users: **Odds Ratio**						
Product	**Odds Ratio (effect size)**	**Standard Error**	**CI Lower Limit**	**CI Upper Limit**	**p-Value**	**Sample Size**
ALEKS	1.737	0.049	1.462	2.064	0.000	10058
Think Through Math	2.412	0.109	1.635	3.559	0.000	1893
iReady	1.452	0.161	0.819	2.574	0.202	947
ST Math	1.072	0.075	0.822	1.398	0.608	1199
Reflex Math	1.234	0.438	0.26	5.848	0.791	293

Table 71. These data are the key results from the logistic regression comparing students with high fidelity software use to those with low fidelity.

Figure 76 and Table 74 display the odds ratios for STEM AC funded students with low fidelity (LF) vs unfunded (UF) students. In contrast to the previous two comparison groups, the two products with statistically significant results had odds ratios less than one. This implies that the unfunded group had greater odds of proficiency compared to the LF STEM AC funded group. In particular, ALEKS students' odds of proficiency were 1/0.748 = 1.34 times greater for the unfunded group compared to their LF peers, with C.I.: (0.628, 0.891). Catch Up Math students had odds of proficiency 2.5 times greater in the unfunded group compared to their LF peers, with C.I.: (0.288, 0.686).

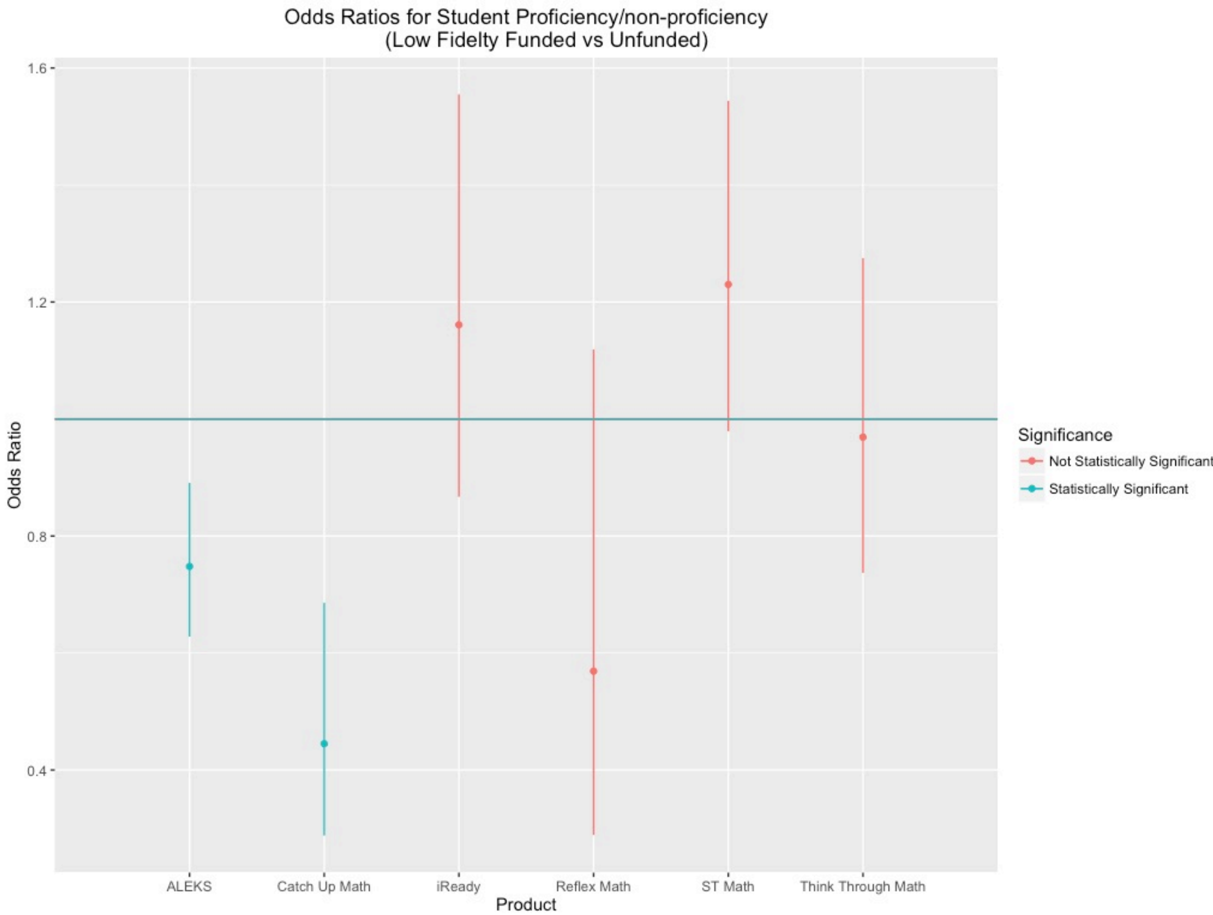


Figure 76. This plot shows the odds ratios with their accompanying .95 confidence intervals resulting from the logistic regression comparing low fidelity users with their unfunded counterparts. Statistically significant results were colored in teal.

Low Fidelity Users Compared to Non STEM AC Funded Students: **Odds Ratio**						
Product	**Odds Ratio (effect size)**	**Standard Error**	**CI Lower Limit**	**CI Upper Limit**	**p-Value**	**Sample Size**
ALEKS	0.748	0.049	0.628	0.891	0.001	12291
Think Through Math	0.969	0.077	0.737	1.275	0.822	6243
iReady	1.161	0.082	0.867	1.555	0.316	1986
ST Math	1.23	0.064	0.979	1.544	0.075	3270
Reflex Math	0.569	0.190	0.289	1.119	0.103	304
Catch Up Math	0.445	0.122	0.288	0.686	0.000	178

Table 72. These data are the key results from the logistic regression comparing LF users to their unfunded counterparts.

Tables 75, 76, and 77 contain the standardized difference in means with their accompanying standard error, confidence intervals, and p-values. As previously mentioned, these are included to facilitate further research using these data. Also, as noted, the Cox transformation was not used, rather the transformation (logged odds)/(1.81) = (standardized difference in means) was used.

High Fidelity Software Users Compared to Non STEM AC Funded Students: **Standardized Difference in Means**					
Product	**Std Diff in Means**	**Standard Error**	**CI Lower Limit**	**CI Upper Limit**	**p-Value**
ALEKS	0.095	0.042	0.014	0.177	0.022
Think Through Math	0.621	0.120	0.387	0.855	0.000
iReady	0.153	0.153	-0.147	0.453	0.317
ST Math	0.230	0.105	0.024	0.436	0.029
Reflex Math	-0.131	0.437	-0.987	0.726	0.765
SuccessMaker	-0.274	0.247	-0.759	0.211	0.268

Table 73. These data give the standardized difference in means with their accompanying statistics for the HF vs UF comparison. Though less interpretable than the odds ratio, these also serve as a standardized effect size.

High Fidelity Software Users Compared to Low Fidelity Software Users: **Standardized Difference in Means**					
Product	**Std Diff in Means**	**Standard Error**	**CI Lower Limit**	**CI Upper Limit**	**p-Value**
ALEKS	0.304	0.049	0.209	0.399	0.000
Think Through Math	0.485	0.109	0.271	0.700	0.000
iReady	0.206	0.161	-0.110	0.521	0.202
ST Math	0.038	0.075	-0.108	0.185	0.608
Reflex Math	0.116	0.438	-0.742	0.974	0.791

Table 74. These data give the standardized difference in means with their accompanying statistics for the HF vs LF comparison. Though less interpretable than the odds ratio, these also serve as a standardized effect size.

Low Fidelity Software Users Compared to Non STEM AC Funded Students: **Standardized Difference in Means**					
Product	**Std Diff in Means**	**Standard Error**	**CI Lower Limit**	**CI Upper Limit**	**p-Value**
ALEKS	-0.160	0.049	-0.257	-0.064	0.001
Think Through Math	-0.017	0.077	-0.168	0.134	0.822
iReady	0.082	0.082	-0.079	0.243	0.316
ST Math	0.114	0.064	-0.011	0.240	0.075
Reflex Math	-0.311	0.190	-0.684	0.062	0.103
Catch Up Math	-0.446	0.122	-0.686	-0.207	0.000

Table 75. These data give the standardized difference in means with their accompanying statistics for the LF vs UF comparison. Though less interpretable than the odds ratio, these also serve as a standardized effect size.

Discussion

The principal results from the analysis of students SAGE scores were the odds ratios produced by the logistic regressions computed for the three pairwise compared groups: high fidelity (HF), or those students who used STEM AC funded software and exceeded the vendor defined fidelity benchmark; low fidelity (LF), or those students who used STEM AC funded software below the fidelity benchmark; and unfunded (UF), or those students who did not use STEM AC funded software. For the HF vs UF groups, the odds of proficiency on the math SAGE assessment were greater for students using ALEKS (≈1.2 times greater), ST Math (≈1.5 times greater), and Think Through Math (≈3 times greater) with HF. Two of these software products, ALEKS and Think Through Math, also had higher odds of proficiency for students using the software with HF versus those students who had LF. In this case the odds were ≈1.7 times greater for ALEKS and ≈2.4 times greater for Think Through Math. The final comparison, between LF and UF students, had a negative association for ALEKS and Catch Up Math users. This negative relationship means that UF students had greater odds of proficiency. In particular, unfunded students had ≈1.34 greater odds of proficiency compared to LF ALEKS users and

≈2.5 times greater odds compared to LF Catchup Math users.

The principal limitation in this study is statistical bias introduced through exclusion of confounding variables. Although no statistical model is perfect, that is, every model includes some bias, clearly, controlling for as many confounding variables as possible is desirable. Figure 77 gives a graphical description of the effects of bias in obtaining the desired results from a statistical analysis. In general, the greater the bias, the less accurate the results.

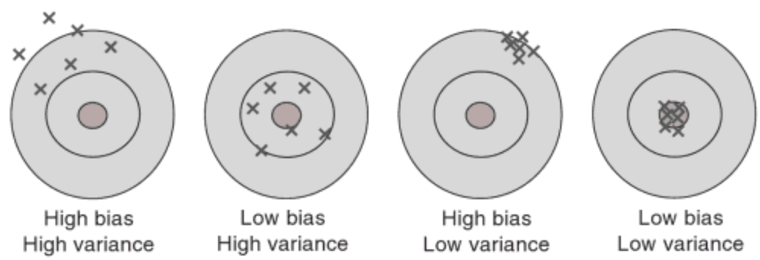


Figure 77. *This analogy was adapted from the "Dartboard analogy" from Moore, McCabe, & Craig (2009). Bias contained within the SAGE score data decreases the accuracy of the statistical models used in SAGE score analysis. Computation using these models is similar to throwing darts at a dart board where each throw is like using a different sample. However, if the sample used in the model contains bias, the model is less likely to hit the bullseye. That is, the greater the bias, the less accurate the results. Using covariates, or controls, that are also confounding variables is one way to decrease, but not eliminate, bias.*

As a concrete example, to obtain the comparison groups defined above, a method called propensity score matching was used. Although propensity score matching approximates a comparison group, it does not control for unknown treatment (i.e., software use) in the matched comparison group, unless data regarding software use in the comparison group is used as a control. In the matched comparisons, HF vs UF and LF vs UF, software use was not measured, and it is possible that a considerable number of students in these groups used mathematics software. In the future, we recommend that evaluation of these programs be designed to control for software use between the treatment and comparison groups. This may increase the reliability and validity of the results. One way this could be accomplished would be to randomly distribute surveys to unfunded schools to determine the level of math software use among Utah public school students.

In addition to controlling for software use between the two groups, prior year's software use may also have an effect on SAGE outcomes. Since this is a multi-year study, it is likely that many students in the treatment group have used the software for more than one year. Prior year's software use was not directly measured in this evaluation study, though prior year's SAGE scores were used as a control in both the propensity score matching and the logistic regressions completed. This provides some control for prior use, however, with the available data, prior year's use could directly be controlled in the future. Thus, to improve the reliability and validity of future evaluations, we recommend that prior use be measure across multiple years.

Given the limitations outlined above, the results obtained through this analysis show a positive association in student outcomes for some products where students had HF use, and a negative association for students who had LF use. This suggests that further study of the links between HF software use and students SAGE scores may lead to a better understanding the effects of software use on student outcomes. Thus, we recommend that future evaluations examine these associations with reduced bias.

References

Avellar, S.A., & Thomas, J. (2014). On equal footing: the importance of baseline equivalence in measuring program effectiveness (Report No. 2014-50). Mathematica Policy Research.

Craig, B., Moore, D. S., & McCabe, G. P. (2009). Introduction to the practice of statistics.

Garrido, M.M., Kelley, A.S., Paris, J., Roza, K., Meier, D.E., Morrison, R.S., & Aldridge, M.D. (2014). Methods for constructing and assessing propensity scores. *Health Services Research*, 49, 1701-1720. DOI: 10.1111/1475-6773.12182

King, G., Nielsen, R. (2016). Why propensity scores should not be used for matching. Cambridge, MA: Massachusetts Institute of Technology. Website: j.mp/PScore

Kutner, M.H., Nachtsheim, C.J., Neter, J. (2004). Applied linear regression models.

Peikes, D.N., Moreno, L., & Orzol, S.M. (2012). Propensity score matching: a note of caution for evaluators of social programs. *The American Statistician*, 62, 1537-2731. DOI: 10.1198/000313008X332016

Reiter, J. P. (2000). Using statistics to determine causal relationships. *American Mathematical Monthly*.

Rice, J.A. (2006). Mathematical statistics and data analysis.

What works clearinghouse: procedures and standards handbook (version 2.0). (2008). Institute of Educational Sciences. Washington, DC.

Appendix B – K-12 Product Descriptions

All providers of K-12 mathematics technology programs had to meet minimum requirements of providing a system that was adaptive and personalized to meet individual student needs. Also required, was a real time reporting feature designed to provide teachers and students with data regarding student progress and opportunities for intervention. The software also had to provide supports to address student needs. We provide a list of the products awarded with a few bullets of what makes each one unique in addition to meeting the minimum requirements.

Grades K-12 Awards

ALEKS, McGraw Hill

- Ongoing assessment with pie chart of mastered grade level skills updated
- Uniquely generated problems and uniquely generated explanations for each student based on highest level of technology available to adapt to students' needs
- Items designed to be similar to Common Core State Standards Assessment items (such as drag and drop)

Catchup Math, Hot Math

- Math lessons are provided in English and Spanish
- Student can watch videos, practice problems done on online whiteboard, play games, receive step-by-step instruction, and take quizzes
- Self-paced and can accommodate individual learning styles

EdReady, NROC

- Teachers can direct students to EdReady Utah to help them prepare for the math portion of the ACT.
- Teachers can see real-time reports that show how their students are doing. As students meet or exceed their target scores, teachers can direct them toward additional steps they may take on their journey to academic and personal success.

iReady, Curriculum Associates

- Developed specifically for the Common Core State Standards
- Able to predict at 85% reliability how a student will do on Common Core State Standards assessments

Math XL, Pearson

- Learning management system where content can be customized by the teacher
- Students can link to learning aids such as the e-book, video clips, and animations to improve their understanding of key concepts
- Problems are regenerated algorithmically to give students unlimited opportunity for practice and mastery

Reflex, Explore Learning

- Online system for math fact fluency in a game-like environment
- More engaging than worksheets used for math fact practice

ST Math, MIND Research

- Developed based on neuroscience research. Students use spatial temporal (ST) reasoning
- Students manipulate visual models to solve problems with no written or oral directions
- Accessible to meet the needs of English language learners and special education students

Think Through Math, Think Through Learning

- Online instruction available through chat box or with headphones by certified teachers in English and Spanish during school, out of school, and weekends
- Use of gamification where students create their own avatar and earn badges
- Competitions with points towards a school or class parties (e.g., pizza party) or as donation to charity of choice

SuccessMaker, Pearson

- Includes scaffolded feedback, step-by-step tutorials and prerequisite instruction triggered when a learner encounters challenges
- Includes game-like features, including speed games for fact fluency

At the start of the 2015-16 school year, we reviewed the products awarded through the Request for Proposal (RFP) process and provided the summary shown in Table 68 to the STEM Action Center, which also includes potential concerns about the products that we would then compare with teacher feedback at the end of the year.

Product, Provider	Description from Provider Which Makes Product Unique beyond what was required in RFP	Potential Concerns
Grades K-12		
ALEKS, McGraw Hill	3rd grade through pre-calculus content. **Ongoing assessment with pie chart of mastered grade level skills updated**. Based on their current knowledge they may only be given 10 skills to learn, when they really have 27 skills to learn so they do not feel overwhelmed. **Uniquely generated problems and uniquely generated explanations for each student based on highest level of technology available to adapt to students**. "I haven't learned this yet" button is to reduce frustration. The student is put in a grade level curriculum, but the program goes lower when students do not have prerequisites. **Items are designed to be similar to Common Core State Standards Assessment items (such as drag and drop)**	Although there are conceptual parts, the procedural parts seem to be more predominant. There is a large amount of reading of information required. In the pilot, this was a concern shared by teachers who work with students with low-level reading.
Catchup Math, Hot Math	Teachers can place a student in a certain grade level content or they can take a placement test to place them at their level. **Math lessons are provided in English and Spanish**, they can do videos, practice problems done on online whiteboard, and games played, step-by step instruction, quizzes. **It is self-paced and can accommodate individual learning styles**. For example, some students mostly watch videos.	The main concern is how effective a self-paced program is to improve student learning. This RFP was for adaptive programs to meet student actual needs, not student perceived needs or areas they want to focus on. There are some nice features, such as how student white board work is saved for teachers to review later. However, the individual learning style is a unique feature, giving

		students more choice, which may be motivating to some students.
iReady, Curriculum Associates	The program was **developed specifically for the Common Core State Standards.** The problem types address procedural and conceptual understanding. It can also accelerate and accommodate below grade level students. A developmental level can be set. **iReady can predict at 85% reliability how a student will do on Common Core State Standards assessments.**	Currently no concerns. This product was not in the pilot, so this year will be the test of how this product is received by teachers and students.
Math XL, Pearson	Learning management system where content can be customized by the teacher. **Students can link to learning aids such as the e-book, video clips, and animations to improve their understanding of key concepts**. The problems are regenerate algorithmically to give students unlimited opportunity for practice and mastery.	Since the teacher can do quite a bit of customization, it is not clear how much the software will be allowed to be completely personalized. However, within the content teachers select, the program will adapt to student needs.
Reflex, Explore Learning	This is an online system for **math fact fluency in a game-like environment**. More engaging than worksheets used for math fact practice.	This product addresses only a small number of Utah Core Standards related to basic fact mastery. If a student does not know a fact, they go into a coaching session, which might show a rule rather than developing conceptual understanding. If students still are not getting it, they recommend teachers work with them with manipulatives.
ST Math, MIND Research	Developed based on **neuroscience research**. Students use **spatial temporal (ST) reasoning**. Students manipulate visual models to solve problems. There are no written or oral directions. When a student gets a problem wrong, they replay the game and they do not get the same questions or levels, because it adapts	Conceptual and less procedural until they master concepts. One concern reported from schools during the pilot was that if a student makes a careless mistake, but actually does know the math it bumps them down several levels, which really frustrates the student. We did

	to student needs. **Accessible to meet the needs of English language learners and special education students.**	have reports from schools that they were seeing great progress from ELL and SPED students.
Think Through Math, Think Through Learning	**Online instruction available through chat box or with headphones by certified teachers in English and Spanish during school, out of school, and weekends**. Immediate corrective feedback. **Use of gamification** where students create their own **avatar and earn badges**. **Competitions** with points **towards a school or class parties** (e.g., pizza party). Points can go towards donations to charity or organization of choice.	We have not seen much of the math content in the RFP presentations, but what we have seen seems procedural. In the pilot one parent voiced concern that her child moved so quickly through the content to advanced grade levels, by just following the kinds and helps, but really did not know what she was doing in the math and the parent couldn't assist her. Schools need to purchase the headsets out of their own funds, because they do not come with the product license. Students begin within Grade Level Pathway, and then they take an adaptive placement test where content is inserted as below grade level precursor lessons to get students back on to grade level. However, it is not as adaptive within the type of feedback students are given.
SuccessMaker, Pearson	Online math curriculum that **differentiates and personalizes instruction**. Includes **scaffolded feedback, step-by-step tutorials** and prerequisite instruction triggered when a learner encounters challenges. It includes some **game-like features.** It includes speed games (fact fluency).	Students are given grade level content. The program seems to provide too much scaffolding, which reduces the opportunity for students to do the thinking. The scaffolding is done in a way to focus on accuracy, rules, and procedures rather than allowing for different solution pathways. Students are placed at grade level, and may struggle if they are not at grade level. In the pilot schools complained that if a student did not log off, all of their work for that session was lost. Teachers also were concerned because the student performance scores had most

		students scoring similarly, when teachers knew that students were very different in their level of understanding.

Table 76. Overview of Products, Product Features, and Potential Concern (Brasiel & Martin, 2015)

Appendix C – School Improvement Network Edivate Licenses Distributed

The School Improvement Network (SINET) provided a user file of summary information with district name, school name, teacher who participated in the PD project, personnel ID, and usage. In the table below, we summarize the licenses distributed during the 2015-2016 school year according to the summary level data that SINET provided.

District/ Charter	School	Licenses Distributed
ALPINE DISTRICT	EAGLE VALLEY ELEMENTARY	38
	FOX HOLLOW ELEMENTARY	46
	HARVEST ELEMENTARY	37
	NORTH POINT ELEMENTARY	1
	WESTLAKE HIGH	12
	WILLOWCREEK MIDDLE	3
	*CENTRAL OFFICE	23
	ALPINE ELEMENTARY	31
	ALPINE ONLINE SCHOOL	2
	AMERICAN FORK HIGH	16
	AMERICAN FORK JR HIGH	3
	ASPEN ELEMENTARY	31
	BARRATT ELEMENTARY	35
	BONNEVILLE ELEMENTARY	1
	CANYON VIEW JR HIGH	4
	CASCADE ELEMENTARY	3
	CEDAR RIDGE ELEMENTARY	1
	CENTRAL ELEMENTARY	31
	DAN W PETERSON SCHOOL	1
	FOOTHILL ELEMENTARY	32
	FREEDOM ELEMENTARY	51
	FRONTIER MIDDLE	6
	GREENWOOD ELEMENTARY	38
	GROVECREST ELEMENTARY	34
	HIGHLAND ELEMENTARY	38
	LAKERIDGE JR HIGH	2
	LEHI ELEMENTARY	33
	LEHI HIGH	12
	LEHI JR HIGH	74
	LINDON ELEMENTARY	34
	LONE PEAK HIGH	1
	MANILA ELEMENTARY	34
	MEADOW ELEMENTARY	35
	MOUNTAIN RIDGE JR HIGH	74
	MOUNTAIN TRAILS ELEMENTARY	34
	MOUNTAIN VIEW HIGH	10

	NORTHRIDGE ELEMENTARY	36
	OAK CANYON JR HIGH	13
	ORCHARD ELEMENTARY	2
	OREM ELEMENTARY	4
	OREM HIGH	4
	OREM JR HIGH	6
	PLEASANT GROVE HIGH	2
	PLEASANT GROVE JR HIGH	1
	POLARIS HIGH	3
	PONY EXPRESS ELEMENTARY	41
	RIVERVIEW ELEMENTARY	35
	ROCKY MOUNTAIN ELEMENTARY	31
	SCERA PARK ELEMENTARY	28
	SHARON ELEMENTARY	30
	SHELLEY ELEMENTARY	32
	SUMMIT HIGH	1
	THUNDER RIDGE ELEMENTARY	1
	TIMBERLINE MIDDLE	7
	TIMPANOGOS HIGH	4
	VINEYARD ELEMENTARY	45
	VISTA HEIGHTS MIDDLE	73
	TOTAL	**1260**
BEAVER DISTRICT	*CENTRAL OFFICE	7
	BEAVER HIGH	24
	BELKNAP ELEMENTARY	28
	MILFORD ELEMENTARY	15
	MILFORD HIGH	13
	MINERSVILLE ELEMENTARY	11
	TOTAL	**98**
BEEHIVE SCIENCE & TECHNOLOGY ACADEMY (BSTA)	*CENTRAL OFFICE	22
	TOTAL	**22**
C.S. LEWIS ACADEMY	C.S. LEWIS ACADEMY	24
	TOTAL	**24**
CACHE DISTRICT	CANYON ELEMENTARY	26
	MOUNTAINSIDE ELEMENTARY	26
	*CENTRAL OFFICE	76
	BRICH CREEK ELEMENTARY	30
	CACHE HIGH	22
	CEDAR RIDGE MIDDLE	40
	GREENVILLE ELEMENTARY	37
	HERITAGE ELEMENTARY	27
	LEWISTON ELEMENTARY	26
	LINCOLN ELEMENTARY	26
	MILLVILLE ELEMENTARY	25
	MOUNTAIN CREST HIGH	107
	NIBLEY ELEMENTARY	20
	NORTH CACHE CENTER	54
	NORTH PARK ELEMENTARY	28
	PARK ELEMENTARY	21
	PROVIDENCE ELEMENTARY	28
	RIVER HEIGHTS ELEMENTARY	23

	SKY VIEW HIGH	109
	SOUTH CACHE CENTER	65
	SPRING CREEK MIDDLE	37
	SUMMIT ELEMENTARY	28
	SUNRISE ELEMENTARY	32
	WELLSVILLE ELEMENTARY	20
	WHITE PINE MIDDLE	27
	WILLOW VALLEY MIDDLE	34
	TOTAL	**994**
CANYONS DISTRICT	*Central Office	150
	ALBION MIDDLE	48
	ALTA HIGH	135
	ALTA VIEW ELEMENTARY	27
	ALTARA ELEMENTARY	28
	BELL VIEW ELEMENTARY	23
	BELLA VISTA ELEMENTARY	20
	BRIGHTON HIGH	118
	BROOKWOOD ELEMENTARY	23
	BUTLER ELEMENTARY	28
	BUTLER MIDDLE	51
	CANYON VIEW ELEMENTARY	22
	COPPERVIEW ELEMENTARY	32
	CORNER CANYON HIGH	106
	CRESCENT ELEMENTARY	33
	CTEC HIGH	34
	DRAPER ELEMENTARY	33
	DRAPER PARK MIDDLE	70
	EAST MIDVALE ELEMENTARY	39
	EAST SANDY ELEMENTARY	25
	EASTMONT MIDDLE	49
	EDGEMONT ELEMENTARY	25
	ENTRADA ADULT HIGH	9
	GRANITE ELEMENTARY	27
	HILLCREST HIGH	115
	INDIAN HILLS MIDDLE	57
	JORDAN HIGH	106
	JORDAN VALLEY	40
	LONE PEAK ELEMENTARY	37
	MIDVALE ELEMENTARY	49
	MIDVALE MIDDLE	55
	MIDVALLEY ELEMENTARY	26
	MOUNT JORDAN MIDDLE	46
	OAK HOLLOW ELEMENTARY	33
	OAKDALE ELEMENTARY	22
	PARK LANE ELEMENTARY	26
	PERUVIAN PARK ELEMENTARY	30
	PRESCHOOL	16
	QUAIL HOLLOW ELEMENTARY	28
	RIDGECREST ELEMENTARY	28
	SANDY ELEMENTARY	32
	SILVER MESA ELEMENTARY	31
	SOUTH PARK ACADEMY	20
	SPRUCEWOOD ELEMENTARY	31

	SUNRISE ELEMENTARY	31
	UNION MIDDLE	50
	WILLOW CANYON ELEMENTARY	24
	WILLOW SPRINGS ELEMENTARY	37
	TOTAL	**2125**
CARBON DISTRICT	BRUIN POINT ELEMENTARY	9
	*CENTRAL OFFICE	14
	CARBON HIGH	40
	CASTLE HEIGHTS ELEMENTARY	28
	CASTLE VALLEY CENTER	10
	CREEKVIEW ELEMENTARY	26
	HELPER MIDDLE	13
	LIGHTHOUSE HIGH	11
	MONT HARMON MIDDLE	37
	SALLY MAURO ELEMENTARY	18
	WELLINGTON ELEMENTARY	18
	TOTAL	**224**
DAGGETT DISTRICT	FLAMING GORGE ELEMENTARY	1
	MANILA ELEMENTARYOOL	15
	MANILA HIGH	14
	TOTAL	**30**
DAVIS DISTRICT	BUFFALO POINT ELEMENTARY	41
	ELLISON PARK ELEMENTARY	37
	LEGACY JR HIGH	56
	PARKSIDE ELEMENTARY	24
	SAND SPRINGS SCHOOL	44
	SNOW HORSE ELEMENTARY	33
	SYRACUSE HIGH	96
	*CENTRAL OFFICE	51
	ADAMS ELEMENTARY	25
	ADELAIDE ELEMENTARY	27
	ANTELOPE ELEMENTARY	33
	BLUFF RIDGE ELEMENTARY	39
	BOULTON ELEMENTARY	24
	BOUNTIFUL ELEMENTARY	21
	BOUNTIFUL HIGH	74
	BOUNTIFUL JR HIGH	32
	CENTENNIAL JR HIGH	59
	CENTERVILLE ELEMENTARY	23
	CENTERVILLE JR HIGH	49
	CENTRAL DAVIS JR HIGH	45
	CLEARFIELD HIGH	89
	CLEARFIELD JOB CORPS	1
	CLINTON ELEMENTARY	19
	COLUMBIA ELEMENTARY	29
	COOK ELEMENTARY	36
	CREEKSIDE ELEMENTARY	31
	CRESTVIEW ELEMENTARY	18
	DAVIS HIGH	108
	DOXEY ELEMENTARY	21
	EAGLE BAY ELEMENTARY	38
	EAST LAYTON ELEMENTARY	24
	ENDEAVOUR ELEMENTARY	43

	FAIRFIELD JR HIGH	52
	FARMINGTON ELEMENTARY	21
	FARMINGTON JR HIGH	44
	FOXBORO ELEMENTARY	24
	FREMONT ELEMENTARY	17
	H C BURTON ELEMENTARY	39
	HERITAGE ELEMENTARY	42
	HILL FIELD ELEMENTARY	22
	HOLBROOK ELEMENTARY	19
	HOLT ELEMENTARY	24
	J A TAYLOR ELEMENTARY	14
	KAYSVILLE ELEMENTARY	28
	KAYSVILLE JR HIGH	47
	KING ELEMENTARY	27
	KNOWLTON ELEMENTARY	33
	LAKESIDE ELEMENTARY	36
	LAYTON ELEMENTARY	27
	LAYTON HIGH	88
	LEO J MUIR ELEMENTARY	21
	LINCOLN ELEMENTARY	32
	MEADOWBROOK ELEMENTARY	19
	MILLCREEK JR HIGH	34
	MORGAN ELEMENTARY	29
	MOUNTAIN HIGH	31
	MOUNTAIN VIEW ELEMENTARY	35
	MUELLER PARK JR HIGH	36
	NORTH DAVIS JR HIGH	59
	NORTH LAYTON JR HIGH	48
	NORTHRIDGE HIGH	91
	OAK HILLS ELEMENTARY	17
	ODYSSEY ELEMENTARY	24
	ORCHARD ELEMENTARY	28
	READING ELEMENTARY	22
	RENAISSANCE ACADEMY	6
	SOUTH CLEARFIELD ELEMENTARY	27
	SOUTH DAVIS JR HIGH	51
	SOUTH WEBER ELEMENTARY	29
	STEPS	5
	STEWART ELEMENTARY	29
	SUNSET ELEMENTARY	19
	SUNSET JR HIGH	46
	SYRACUSE ELEMENTARY	39
	SYRACUSE JR HIGH	51
	TOLMAN ELEMENTARY	19
	VAE VIEW ELEMENTARY	20
	VALLEY VIEW ELEMENTARY	23
	VIEWMONT HIGH	89
	WASATCH ELEMENTARY	22
	WASHINGTON ELEMENTARY	15
	WEST BOUNTIFUL ELEMENTARY	26
	WEST CLINTON ELEMENTARY	35
	WEST POINT ELEMENTARY	31
	WEST POINT JR HIGH	66

	WHITESIDES ELEMENTARY	19
	WINDRIDGE ELEMENTARY	28
	WOODS CROSS ELEMENTARY	26
	WOODS CROSS HIGH	74
	TOTAL	**3215**
EXCELSIOR ACADEMY	EXCELSIOR ACADEMY	33
	TOTAL	**33**
GRANITE DISTRICT	*CENTRAL OFFICE	2
	*DEPT OF TEACHING & LEARNING	14
	ACADEMY PARK ELEMENTARY	4
	ALTER SAFE SCH-JR HIGH	1
	ALTER SAFE SCH-SR HIGH	3
	ARCADIA ELEMENTARY	7
	ARMSTRONG ACADEMY	1
	BONNEVILLE JR HIGH	1
	BROCKBANK JR HIGH	16
	CALVIN S SMITH ELEMENTARY	12
	COTTONWOOD ELEMENTARY	1
	DAVID GOURLEY ELEMENTARY	1
	DOUGLAS T ORCHARD ELEMENTARY	10
	EASTWOOD ELEMENTARY	4
	EISENHOWER JR HIGH	69
	EVERGREEN JR HIGH	16
	FOX HILLS ELEMENTARY	11
	GRANGER ELEMENTARY	20
	GRANGER HIGH	84
	GRANITE PARK JR HIGH	12
	GRANITE PEAKS HIGH	29
	GRANITE TECHNICAL INSTITUTE (CTE)	5
	HARRY S TRUMAN ELEMENTARY	8
	HARTVIGSEN SCHOOL	4
	HILLSDALE ELEMENTARY	10
	HILLSIDE ELEMENTARY	1
	HUNTER ELEMENTARY	12
	JAMES E MOSS ELEMENTARY	1
	KEARNS JR HIGH	19
	LAKE RIDGE ELEMENTARY	8
	LINCOLN ELEMENTARY	28
	MONROE ELEMENTARY	15
	OAKWOOD ELEMENTARY	4
	PHILO T FARNSWORTH ELEMENTARY	14
	PIONEER ELEMENTARY	5
	REDWOOD ELEMENTARY	8
	ROBERT FROST ELEMENTARY	34
	ROLLING MEADOWS ELEMENTARY	40
	ROOSEVELT ELEMENTARY	8
	ROSECREST ELEMENTARY	11
	SALT LAKE CO DETNTN CTR-JR HIGH	2
	SCOTT M MATHESON JR HIGH	21
	SILVER HILLS ELEMENTARY	1
	SKYLINE HIGH	11
	SOUTH KEARNS ELEMENTARY	14
	SPEECH ONLY	1

	SPRING LANE ELEMENTARY	4
	STANSBURY ELEMENTARY	23
	TAYLORSVILLE ELEMENTARY	41
	TAYLORSVILLE HIGH	110
	TEEN PARENT	2
	THOMAS JEFFERSON JR HIGH	17
	THOMAS W BACCHUS ELEMENTARY	12
	TWIN PEAKS ELEMENTARY	11
	UPLAND TERRACE ELEMENTARY	8
	VALLEY CREST ELEMENTARY	15
	VALLEY JR HIGH	20
	VISTA ELEMENTARY	15
	WASATCH JR HIGH	8
	WASATCH YOUTH CENTER	1
	WEST KEARNS ELEMENTARY	7
	WEST LAKE JR HIGH	68
	WEST VALLEY ELEMENTARY	7
	WESTBROOK ELEMENTARY	11
	WESTERN HILLS ELEMENTARY	12
	WHITTIER ELEMENTARY	7
	WILLIAM PENN ELEMENTARY	26
	WOODROW WILSON ELEMENTARY	61
	WOODSTOCK ELEMENTARY	10
	YESS PROGRAM	1
	TOTAL	**1100**
IRON DISTRICT	CANYON VIEW MIDDLE	47
	IRON SPRINGS ELEMENTARY	1
	*CENTRAL OFFICE	5
	CEDAR HIGH	3
	CEDAR MIDDLE	48
	ESCALANTE VALLEY ELEMENTARY	1
	NORTH ELEMENTARY	23
	PAROWAN HIGH	26
	TOTAL	**154**
JUAB DISTRICT	NEBO VIEW ELEMENTARY	17
	RED CLIFFS ELEMENTARY	26
	*CENTRAL OFFICE	3
	JUAB HIGH	33
	JUAB JR. HIGH	19
	MONA ELEMENTARY	18
	TOTAL	**116**
LOGAN DISTRICT	BRIDGER ELEMENTARY	24
	*CENTRAL OFFICE	8
	ADAMS ELEMENTARY	16
	ELLIS ELEMENTARY	16
	HILLCREST ELEMENTARY	20
	LOGAN HIGH	83
	MT LOGAN MIDDLE	71
	WILSON ELEMENTARY	21
	WOODRUFF ELEMENTARY	29
	TOTAL	**288**
MANA ACADEMY CHARTER SCHOOL	*CENTRAL OFFICE	46

	TOTAL	**46**
MOAB COMMUNITY SCHOOL	*CENTRAL OFFICE	14
	TOTAL	**14**
MONTICELLO ACADEMY	MONTICELLO ACADEMY	43
	TOTAL	**43**
MURRAY DISTRICT	EARLY CHILDHOOD CTR	3
	*CENTRAL OFFICE	6
	CREEKSIDE HIGH	1
	GRANT ELEMENTARY	20
	HILLCREST JR HIGH	42
	HORIZON ELEMENTARY	36
	LIBERTY ELEMENTARY	24
	LONGVIEW ELEMENTARY	20
	MC MILLAN ELEMENTARY	22
	MURRAY HIGH	80
	PARKSIDE ELEMENTARY	29
	RIVERVIEW JR HIGH	40
	VIEWMONT ELEMENTARY	23
	TOTAL	**346**
NORTH SANPETE DISTRICT	*CENTRAL OFFICE	27
	FAIRVIEW ELEMENTARY	32
	FOUNTAIN GREEN ELEMENTARY	20
	MORONI ELEMENTARY	35
	MT PLEASANT ELEMENTARY	56
	NORTH SANPETE HIGH	84
	NORTH SANPETE MIDDLE	39
	PLEASANT CREEK HIGH	18
	SPRING CITY ELEMENTARY	19
	SUBSTITUTE	70
	TRANSPORTATION	26
	TOTAL	**426**
NORTH SUMMIT DISTRICT	*CENTRAL OFFICE	4
	NORTH SUMMIT ELEMENTARY	23
	NORTH SUMMIT HIGH	21
	NORTH SUMMIT MIDDLE	18
	TOTAL	**66**
NEBO DISTRICT	CHERRY CREEK ELEMENTARY	27
	DIAMOND FORK JR HIGH	26
	EAST MEADOWS ELEMENTARY	23
	FOOTHILLS ELEMENTARY	18
	MAPLE MOUNTAIN HIGH	23
	MAPLETON JR HIGH	28
	MT. NEBO JR HIGH	10
	ORCHARD HILLS ELEMENTARY	25
	RIVERVIEW ELEMENTARY	18
	SALEM HILLS HIGH	32
	*CENTRAL OFFICE	79
	ALC	5
	ART CITY ELEMENTARY	12

	BARNETT ELEMENTARY	23
	BROCKBANK ELEMENTARY	28
	BROOKSIDE ELEMENTARY	25
	CANYON ELEMENTARY	12
	GOSHEN ELEMENTARY	16
	HOBBLE CREEK ELEMENTARY	13
	LANDMARK HIGH	22
	LARSEN ELEMENTARY	17
	MAPLE RIDGE ELEMENTARY	4
	MAPLETON ELEMENTARY	14
	MT LOAFER ELEMENTARY	12
	OAKRIDGE SCHOOL--NEBO	2
	PARK ELEMENTARY	15
	PARKVIEW ELEMENTARY	20
	PAYSON HIGH	26
	PAYSON JR HIGH	26
	REES ELEMENTARY	23
	SAGE CREEK ELEMENTARY	26
	SALEM ELEMENTARY	13
	SALEM JR HIGH	25
	SANTAQUIN ELEMENTARY	23
	SIERRA BONITA ELEMENTARY	10
	SPANISH FORK HIGH	37
	SPANISH FORK JR HIGH	32
	SPANISH OAKS ELEMENTARY	18
	SPRING LAKE ELEMENTARY	30
	SPRINGVILLE HIGH	47
	SPRINGVILLE JR HIGH	19
	TAYLOR ELEMENTARY	17
	WESTSIDE ELEMENTARY	39
	WILSON ELEMENTARY	15
	TOTAL	**975**
NO UT ACAD FOR MATH ENGIN & SCI (NUAMES) AGENCY	NO UT ACAD FOR MATH ENGIN & SCI (NUAMES)	40
	TOTAL	**40**
NOAH WEBSTER ACADEMY	NOAH WEBSTER ACADEMY	36
	TOTAL	**36**
PARK CITY DISTRICT	*CENTRAL OFFICE	5
	ECKER HILL MIDDLE	57
	JEREMY RANCH ELEMENTARY	36
	MC POLIN ELEMENTARY	29
	PARK CITY HIGH	77
	PARK CITY LEARNING CTR	11
	PARLEYS PARK ELEMENTARY	41
	TRAILSIDE ELEMENTARY	34
	TREASURE MTN MIDDLE	49
	TOTAL	**339**
PINNACLE CANYON ACAD AGENCY	PINNACLE CANYON ACADEMY	48
	TOTAL	**48**
PIUTE DISTRICT	*CENTRAL OFFICE	2

	CIRCLEVILLE ELEMENTARY	15
	OSCARSON ELEMENTARY	4
	PIUTE HIGH	18
	TOTAL	**39**
PROVIDENCE HALL	*CENTRAL OFFICE	42
	PROVIDENCE HALL ELEMENTARY	42
	PROVIDENCE HALL HIGH	1
	PROVIDENCE HALL JR HIGH	45
	TOTAL	**130**
PROVO DISTRICT	*CENTRAL OFFICE	62
	AMELIA EARHART ELEMENTARY	32
	CANYON CREST ELEMENTARY	30
	CENTENNIAL MIDDLE	3
	DIXON MIDDLE	51
	E-SCHOOL	6
	EAST BAY POST HIGH	6
	EDGEMONT ELEMENTARY	35
	FRANKLIN ELEMENTARY	27
	INDEPENDENCE HIGH	22
	IVY HALL ACADEMY	11
	LAKEVIEW ELEMENTARY	38
	OAK SPRINGS SCH (ELEMENTARY-SEC)	8
	PROVO ADULT EDUCATION	13
	PROVO HIGH	91
	PROVO PEAKS ELEMENTARY	41
	PROVOST ELEMENTARY	20
	ROCK CANYON ELEMENTARY	29
	SLATE CANYON DTN HOME	13
	SPRING CREEK ELEMENTARY	35
	SUNRISE PRESCHOOL	15
	SUNSET VIEW ELEMENTARY	30
	TIMPANOGOS ELEMENTARY	39
	TIMPVIEW HIGH	5
	WASATCH ELEMENTARY	46
	WESTRIDGE ELEMENTARY	93
	TOTAL	**801**
QUEST ACADEMY	QUEST ACADEMY	79
	TOTAL	**79**
RICH DISTRICT	*CENTRAL OFFICE	6
	NO RICH ELEMENTARY	16
	RICH HIGH	15
	RICH MIDDLE	8
	SOUTH RICH ELEMENTARY	14
	TOTAL	**59**
SOUTH SANPETE DISTRICT	*CENTRAL OFFICE	9
	CENTRAL UTAH ACADEMY (CUA)	13
	EPHRAIM ELEMENTARY	29
	EPHRAIM MIDDLE	28
	GUNNISON VALLEY ELEMENTARY	27
	GUNNISON VALLEY HIGH	37
	GUNNISON VALLEY MIDDLE	13
	MANTI ELEMENTARY	26

	MANTI HIGH	39
	YWEC (YIC)	8
	TOTAL	**229**
SOUTH SUMMIT DISTRICT	*CENTRAL OFFICE	5
	SOUTH SUMMIT ELEMENTARY	43
	SOUTH SUMMIT HIGH	28
	SOUTH SUMMIT MIDDLE	30
	TOTAL	**106**
SALT LAKE CENTER FOR SCIENCE EDUCATION	SALT LAKE CENTER FOR SCIENCE EDUCATION	28
	TOTAL	**28**
SAN JUAN DISTRICT	*CENTRAL OFFICE	10
	ALBERT R LYMAN MIDDLE	21
	BLANDING ELEMENTARY	30
	BLUFF ELEMENTARY	9
	LA SAL ELEMENTARY	2
	MONTEZUMA CREEK ELEMENTARY	14
	MONTICELLO ELEMENTARY	17
	MONTICELLO HIGH	26
	MONUMENT VALLEY HIGH	20
	NAVAJO MOUNTAIN HIGH	5
	SAN JUAN HIGH	25
	TSE'BII'NIDZISGAI ELEMENTARY	19
	WHITEHORSE HIGH	22
	TOTAL	**220**
SUMMIT ACAD AGENCY	SUMMIT ACADEMY - DRAPER	78
	*CENTRAL OFFICE	1
	SUMMIT ACADEMY HIGH	40
	SUMMIT ACADEMY INDEPENDENCE K-8	49
	TOTAL	**168**
SYRACUSE ARTS ACADEMY	SYRACUSE ARTS ACADEMY	51
	TOTAL	**51**
TINTIC DISTRICT	*CENTRAL OFFICE	9
	EUREKA ELEMENTARY	14
	TINTIC HIGH	8
	WEST DESERT ELEMENTARY	1
	WEST DESERT HIGH	1
	TOTAL	**33**
UTAH SCHOOLS FOR DEAF & BLIND	UTAH SCHOOLS FOR DEAF & BLIND	240
	TOTAL	**240**
WASHINGTON DISTRICT	ARROWHEAD SCHOOL	35
	CORAL CANYON ELEMENTARY SCHOOL	29
	DESERT HILLS HIGH	65
	FOSSIL RIDGE INTERMEDIATE	42
	HORIZON ELEMENTARY SCHOOL	36
	HURRICANE INTERMEDIATE	34
	LITTLE VALLEY SCHOOL	35
	SOUTHWEST HIGH & BEHAVIORAL HEALTH	6

	SUNRISE RIDGE INTERMEDIATE SCHOOL	50
	TONAQUINT INTERMEDIATE SCHOOL	37
	WASHINGTON COUNTY ONLINE SCHOOL	1
	*ARCHIVED	262
	*CENTRAL OFFICE	78
	BLOOMINGTON ELEMENTARY	30
	BLOOMINGTON HILLS ELEMENTARY	28
	CORAL CLIFFS ELEMENTARY	32
	CRIMSON VIEW ELEMENTARY	31
	DESERT HILLS MIDDLE	42
	DIAMOND VALLEY ELEMENTARY	15
	DIXIE HIGH	64
	DIXIE MIDDLE	39
	DIXIE SUN ELEMENTARY	33
	EARLY CHILDHOOD PRESCHOOL	26
	EAST ELEMENTARY	38
	ENTERPRISE ELEMENTARY	24
	ENTERPRISE HIGH	33
	HERITAGE ELEMENTARY	39
	HURRICANE ELEMENTARY	33
	HURRICANE HIGH	51
	HURRICANE MIDDLE	35
	LA VERKIN ELEMENTARY	30
	LAVA RIDGE INTER	44
	MAINTENANCE	2
	MILLCREEK HIGH	21
	PANORAMA ELEMENTARY	23
	PINE VIEW HIGH	62
	PINE VIEW MIDDLE	42
	POST HIGH SCH (SELF-CONT)	10
	RED MOUNTAIN ELEMENTARY	29
	RIVERSIDE SCHOOL	34
	SANDSTONE ELEMENTARY	31
	SANTA CLARA ELEMENTARY	26
	SNOW CANYON HIGH	60
	SNOW CANYON MIDDLE	45
	SPRINGDALE ELEMENTARY	4
	STARS	3
	SUCCESS ACADEMY DIXIE	1
	SUNSET ELEMENTARY	33
	TECHNOLOGY	2
	THREE FALLS ELEMENTARY	36
	TITLE 1 PRE-SCHOOL	19
	TRANSPORTATION	1
	UTAH ONLINE HIGH	38
	WASHINGTON ELEMENTARY	29
	WATER CANYON SCHOOL	24
	TOTAL	**1952**
WAYNE DISTRICT	*CENTRAL OFFICE	1
	HANKSVILLE ELEMENTARY	6
	LOA ELEMENTARY	23
	WAYNE HIGH	18
	WAYNE MIDDLE	14

	TOTAL	**62**
WEBER DISTRICT	CANYON VIEW PRESCHOOL	6
	ROCKY MOUNTAIN JR HIGH	50
	TWO RIVERS HIGH	42
	WEST HAVEN SCHOOL	41
	*CENTRAL OFFICE	48
	BATES ELEMENTARY	34
	BONNEVILLE HIGH	70
	CANYON VIEW HIGH	34
	CLUB HEIGHTS ELEMENTARY	37
	COUNTRY VIEW ELEMENTARY	28
	FARR WEST ELEMENTARY	41
	FREEDOM ELEMENTARY	38
	FREMONT HIGH	87
	GREEN ACRES ELEMENTARY	30
	H GUY CHILD ELEMENTARY	28
	HOOPER ELEMENTARY	29
	KANESVILLE ELEMENTARY	36
	LAKEVIEW ELEMENTARY	34
	LOMOND VIEW ELEMENTARY	26
	MAJESTIC ELEMENTARY	49
	MARLON HILLS ELEMENTARY	17
	MIDLAND ELEMENTARY	34
	MUNICIPAL ELEMENTARY	23
	NORTH OGDEN ELEMENTARY	30
	NORTH OGDEN JR HIGH	34
	NORTH PARK ELEMENTARY	32
	ORION JR HIGH	45
	PIONEER ELEMENTARY	27
	PLAIN CITY ELEMENTARY	39
	RIVERDALE ELEMENTARY	27
	ROOSEVELT ELEMENTARY	36
	ROY ELEMENTARY	33
	ROY HIGH	91
	ROY JR HIGH	47
	SAND RIDGE JR HIGH	41
	SNOWCREST JR HIGH	21
	SOUTH OGDEN JR HIGH	41
	T H BELL JR HIGH	36
	UINTAH ELEMENTARY	36
	VALLEY ELEMENTARY	28
	VALLEY VIEW ELEMENTARY	36
	WAHLQUIST JR HIGH	54
	WASHINGTON TERRACE ELEMENTARY	37
	WEBER HIGH	100
	WEBER INNOVATION HIGH	14
	WEST WEBER ELEMENTARY	39
	TOTAL	**1786**
GRAND TOTAL		**18,045**

Table 77. SINET Licenses Distributed

Appendix D – Surveys

Student and Teacher K-12 Survey

In the K-6 math interest pre and post-surveys, there were 12 questions in the pre-survey and 11 questions in the post-survey. Student first and last name prompts were remove in the post-survey, under the conjecture that students might feel less pressure answering the remaining prompts. Although the data for the K-6 student pre-survey was still available, the survey instrument was not, thus it is excluded from this appendix.

There are 27 questions in the grade 7-12 student math interest pre-survey, and 26 questions in post-survey. In the post survey, three questions were removed asking students to provide their name and username. Two additional open-ended questions were added, to explore students' thoughts regarding future occupations and whether they thought math would be valuable in their desired job/field.

In the math software teacher surveys, there were 11 questions in pre-survey and 13 questions in post. In the post-survey one question asking teacher to describe "any other ways that teachers have been using any of the data reporting features of the product" was modified to "how did you use the student progress data?" Two questions were added asking teachers, "what PD would be helpful for you to more effectively use the mathematics software with your students?" and "how was having access to the mathematics software influenced your teaching?" Although the data for the K-12 teacher pre survey was still available, the survey instrument was not, thus it was excluded from.

PD

Teacher

There were 16 questions in the teacher professional development (PD) pre-survey and 20 questions in post. There were a few changes in the survey instrument from pre to post-survey. In general, the pre survey asked teachers about their overall satisfaction with the PD so far, while the post survey asked about the effectiveness of the PD. For example, the post-survey asked teachers to describe whether the PD was useful for enhancing teachers' instructional effectiveness, their expected outcome after watching Edivate PD videos, etc. While the data for the pre-survey was available, the survey instrument was not, thus it has been excluded from this appendix.

Principal

There were 10 questions in the PD principal post-survey. While the data for the pre-survey was available, the survey instrument was not, thus it has been excluded from this appendix.

FCC

There were 11 questions in the FCC survey. While the data for the survey was available, the survey instrument was not, thus it has been excluded from appendix.

CTE

Student and Teacher

There were 17 questions in the student CTE pre-survey. Although the data for the CTE post-survey was still available, the survey instrument was not, thus it was excluded from this appendix.

Similarly, there were 34 questions in the CTE teacher pre-survey and 19 questions in the CTE teacher post-survey. The pre and post survey contained different questions, in general in the pre survey we asked teachers about their overall satisfaction with the CTE so far, while the post survey asked about the effectiveness of the CTE, whether the CTE are useful for enhancing teachers teaching effectiveness, their expected outcome for CTE, etc. While the data for the pre-survey was available, the survey instrument was not, thus it has been excluded from this appendix.

K-12 Math Software

K-6 Student Post-Survey

Utah Governor's Office *of* Economic Development

STEM Action Center

Default Question Block

HOW DO YOU FEEL ABOUT MATH?

Directions

We want to know how you feel about math so we can make math class even better for students like you.

There are no good or bad answers. Your teacher will not see your answers. Please tell us what you think.

2. What is the name of your school?

2. What is the name of your school district or charter school?

3. What math program are you using in class?

- ALEKS
- i-Ready
- Successmaker
- ST Math
- Think Through Math
- Reflex

5. Practice Question:

If you think milk is OK then CLICK on the bar and leave it in the middle. If you love milk, move the bar to the very top. If you hate milk, move the bar to the very bottom. YOU MUST CLICK THE BAR TO ANSWER.

How much do you like milk?

Now we want to know about how you feel about math

6. How do you feel about doing math problems **<u>in class</u>**?

7. How do you feel about doing math at home for **homework**?

8. How much **do you like** math?

What do you like or dislike about math?

9. How do you feel when you are doing **easy math tasks**?

10. How do you feel when you are doing **hard math tasks**?

11. Will you need math when you get older and **get a job**?

- ○ No
- ○ Yes

What kind of job do you want to have when you get older?

12. How is math for you **compared to other things** you learn in school? Choose 1 for very easy and up to 10 for much harder than other things you learn in school

We will not tell anyone your answers. We will summarize what all the students in Utah are saying about math in a report. Thank you for telling us about how you feel about math.

7-12 Student Pre-Survey

Utah Governor's Office of Economic Development

STEM Action Center

Default Question Block

Student Math Interest Survey

Directions

We are trying to understand what students think about the work they do for mathematics class. Your responses will help improve math classes for students in Utah. On the following pages are some examples of what students might think. Please give us your rating for each question.

Different students have different interests, so there are no right or wrong answers. Your answers will **not** be used toward your grade and your teacher will not look at your answers. Please answer these questions honestly, and tell us what you **really** think. Information from your answers, and the rest of the participating students in Utah, will be summarized to understand how students feel about math, and how math classes can be improved.

Please select in the choice that best describes what you think. If you make a mistake, you will be able to change your answer before submitting.

Please type your first name.

Please type your last name.

Please type your school name.

Please type your district name or charter school name.

Please choose the math computer game that you are using. If you don't see the name of your game, please ask your teacher

- ALEKS-McGraw Hill
- Carnegie Learning - Cognitive Tutor
- CatchUp Math - Hot Math
- EdReady-Monterey Institute NROC
- i-Ready Curriculum Associates
- Math XL- Pearson
- Odyssey - Compass Learning
- Reflex -Explore Learning
- ST Math- MIND Research Institute
- Think Through Math
- Successmaker-Pearson

Please type your username that you use to play the game

Tell us what you like about the math computer game you use. (Write "nothing" if there is nothing that you like about it.)

Tell us what you do **not** like about the math computer game you use. (Write "nothing" if there is nothing that you do not like about it.)

Practice Question:

*If you are OK at science, check the middle box. If you are good at science, check one of the 3 boxes to the right. Only check the far right box if you are **very good** at science. If you are not so good at science then check one of the 3 boxes to the left, only checking the far left box if you think you are **not at all good** at science.*

How good at science are you?

Not at all Good ○ ○ ○ ○ ○ ○ ○ Very Good

The remainder of the survey questions will be on math.

Begin Math Questions:

In general, I find working on math assignments

Very Boring ○ ○ ○ ○ ○ ○ ○ Very Interesting

How much do you like doing math?

Not Very Much ○ ○ ○ ○ ○ ○ ○ Very Much

Is the amount of effort it will take to do well in advanced high school math courses worthwhile to you?

Not Very Worthwhile ○ ○ ○ ○ ○ ○ ○ Worthwhile

I feel that, to me, being good at solving problems which involve math or reasoning mathematically is

Not at all Important ○ ○ ○ ○ ○ ○ ○ Very Important

How important is it to you to get good grades in math?

Not at all Important ○ ○ ○ ○ ○ ○ ○ Very Important

How useful is learning math for what you want to do after you graduate from high school or college and go to work?

Not at all Useful ○ ○ ○ ○ ○ ○ ○ Very Useful

How useful is what you learn in math class for your daily life outside school?

Not at all Useful ○ ○ ○ ○ ○ ○ ○ Very Useful

Compared to other students, how well do you expect to do in math this year?

Much Worse Than Other Students ○ ○ ○ ○ ○ ○ ○ Much Better Than Other Students

How well do you think you will do in your math class this year?

Very Poorly ○ ○ ○ ○ ○ ○ ○ Very Well

How good at math are you?

Not at all Good ○ ○ ○ ○ ○ ○ ○ Very Good

If you were to order all the students in your math class from the worst to the best in math, where would you put yourself?

The Worst ○ ○ ○ ○ ○ ○ ○ The Best

How have you been doing in math this year?

Very Poorly ○ ○ ○ ○ ○ ○ ○ Very Well

In general, how hard is math for you?

Very Easy ○ ○ ○ ○ ○ ○ ○ Very Hard

Compared to most other students in your class, how hard is math for you?

Much Easier ○ ○ ○ ○ ○ ○ ○ Much Harder

Compared to most other school subjects that you take, how hard is math for you?

My Easiest Course ○ ○ ○ ○ ○ ○ ○ My Hardest Course

How hard would you have to try to do well in a school math course?

Not Very Hard ○ ○ ○ ○ ○ ○ ○ Very Hard

How hard do you have to try to get good grades in math?

A Little ○ ○ ○ ○ ○ ○ ○ A Lot

How hard do you have to study for math tests to get a good grade?

A Little ○ ○ ○ ○ ○ ○ ○ A Lot

To do well in math I have to work

Much Harder in Math than in other Subjects ○ ○ ○ ○ ○ ○ ○ Much Harder in other Subjects than in Math

Your responses to this survey will be used only for statistical purposes. The reports prepared for this study will summarize findings across the students and will not associate responses to any individual. We will not provide information that identifies you or your district to anyone, except as required by law.

7-12 Student Post-Survey

Utah Governor's Office of Economic Development

STEM Action Center

Default Question Block

Student Math Interest Survey

Directions

We are trying to understand what students think about the work they do for mathematics class. Your responses will help improve math classes for students in Utah. On the following pages are some examples of what students might think. Please give us your rating for each question.

Different students have different interests, so there are no right or wrong answers. Your answers will **not** be used toward your grade and your teacher will not look at your answers. Please answer these questions honestly, and tell us what you **really** think. Information from your answers, and the rest of the participating students in Utah, will be summarized to understand how students feel about math, and how math classes can be improved.

Please select in the choice that best describes what you think. If you make a mistake, you will be able to change your answer before submitting.

Please type your school name.

Please type your district name or charter school name.

Please choose the math computer program that you are using. If you don't see the name of your program, please ask your teacher

- ALEKS-McGraw Hill
- Carnegie Learning - Cognitive Tutor
- CatchUp Math - Hot Math
- EdReady-Monterey Institute NROC
- i-Ready Curriculum Associates
- Math XL- Pearson
- Odyssey - Compass Learning
- Reflex -Explore Learning
- ST Math- MIND Research Institute
- Think Through Math
- Successmaker-Pearson

Tell us what you like about the math computer program you use. (Write "nothing" if there is nothing that you like about it.)

Tell us what you do **not** like about the math computer program you use. (Write "nothing" if there is nothing that you do not like about it.)

Practice Question:

*If you are OK at science, check the middle box. If you are good at science, check one of the 3 boxes to the right. Only check the far right box if you are **very good** at science. If you are not so good at science then check one of the 3 boxes to the left, only checking the far left box if you think you are **not at all good** at science.*

How good at science are you?

Not at all Good ○ ○ ○ ○ ○ ○ ○ Very Good

The remainder of the survey questions will be on math.

Begin Math Questions:

In general, I find working on math assignments

Very Boring ○ ○ ○ ○ ○ ○ ○ Very Interesting

How much do you like doing math?

Not Very Much ○ ○ ○ ○ ○ ○ ○ Very Much

Is the amount of effort it will take to do well in advanced high school math courses worthwhile to you?

Not Very Worthwhile ○ ○ ○ ○ ○ ○ ○ Worthwhile

I feel that, to me, being good at solving problems which involve math or reasoning mathematically is

Not at all Important ○ ○ ○ ○ ○ ○ ○ Very Important

How important is it to you to get good grades in math?

Not at all Important ○ ○ ○ ○ ○ ○ ○ Very Important

How useful is learning math for what you want to do after you graduate from high school or college and go to work?

Not at all Useful ○ ○ ○ ○ ○ ○ ○ Very Useful

How useful is what you learn in math class for your daily life outside school?

Not at all Useful ○ ○ ○ ○ ○ ○ ○ Very Useful

Compared to other students, how well do you expect to do in math this year?

Much Worse Than Other Students ○ ○ ○ ○ ○ ○ ○ Much Better Than Other Students

How well do you think you will do in your math class this year?

Very Poorly ○ ○ ○ ○ ○ ○ ○ Very Well

How good at math are you?

Not at all Good ○ ○ ○ ○ ○ ○ ○ Very Good

If you were to order all the students in your math class from the worst to the best in math, where would you put yourself?

The Worst ○ ○ ○ ○ ○ ○ ○ The Best

How have you been doing in math this year?

Very Poorly | ○ ○ ○ ○ ○ ○ ○ | Very Well

In general, how hard is math for you?

Very Easy | ○ ○ ○ ○ ○ ○ ○ | Very Hard

Compared to most other students in your class, how hard is math for you?

Much Easier | ○ ○ ○ ○ ○ ○ ○ | Much Harder

Compared to most other school subjects that you take, how hard is math for you?

My Easiest Course | ○ ○ ○ ○ ○ ○ ○ | My Hardest Course

How hard would you have to try to do well in a school math course?

Not Very Hard | ○ ○ ○ ○ ○ ○ ○ | Very Hard

How hard do you have to try to get good grades in math?

A Little | ○ ○ ○ ○ ○ ○ ○ | A Lot

How hard do you have to study for math tests to get a good grade?

A Little | ○ ○ ○ ○ ○ ○ ○ | A Lot

To do well in math I have to work

Much Harder in Math than in other Subjects ○ ○ ○ ○ ○ ○ ○ Much Harder in other Subjects than in Math

What job would you like to do as an adult?

How do you think you will use mathematics in the job you want to do as an adult?

Your responses to this survey will be used only for statistical purposes. The reports prepared for this study will summarize findings across the students and will not associate responses to any individual. We will not provide information that identifies you or your district to anyone, except as required by law.

Block 1

K-12 Teacher Post-Survey

Utah Governor's Office of Economic Development

STEM Action Center

Default Question Block

Thank you for participating in the Utah STEM Action Center K-12 Math Digital Technology Grant program.

This survey is to be completed to let us know a little bit about your experience using the mathematics technology product your school is using. If you are using more than one product, please complete a survey for each product separately.

Thank you very much for your time. This is extremely valuable feedback to inform future use of these products in the state of Utah.

Please type your school name.

Please type your school district name or name of your charter school.

1 of 6

What is the name of technology product you and your school were selected to use?

If you were selected to use more than one product, please specify the name of the product you will be focusing on for this survey.

- ALEKS
- iReady
- Think Through Math
- ST Math
- Catchup Math
- Odyssey Math
- Reflex
- Cognitive Tutor
- EdReady
- Successmaker
- MathXL

Approximately how many minutes or hours a week are optimal for students to use the software to learn math? (Please specify minutes or hours in your answer).

Please describe how you used the technology product in the last 30 days:

	Select which answer most represents your use of the product in the last 30 days		
	Always	Sometimes	Never
Supplement to reinforce instruction	○	○	○
Intervention to meet needs of below level students	○	○	○
Acceleration to meet needs of above grade level students	○	○	○
Assigned as homework	○	○	○
During whole class instruction to demonstrate or model concepts	○	○	○
In class to engage some students while I work one and one with others	○	○	○
In class for students to test their knowledge and determine their learning progress	○	○	○

Describe your overall satisfaction with the technology product.

Describe whether you had any barriers that prevented you from using the product with your students as you would have liked.

	Describe how often you experienced each type of barrier to product usage.		
	Always	Sometimes	Never
Not enough computers, or lack of access to computers/mobile devices	○	○	○
Internet browser issues	○	○	○
Java issues	○	○	○
Need for more training	○	○	○
Not enough licenses for students	○	○	○
Not accessible from home	○	○	○
Old or outdated technology	○	○	○

Describe any other barriers that prevented you from using the product with your students as much as you would have wanted (Write "none" if you experienced no barriers)

Please describe how you have been using the data reporting features of the product.

	Select how often you use the data reporting features for each type of use		
	Always	Sometimes	Never
Monitor student progress	○	○	○
Inform parents of student progress	○	○	○
Inform students of their progress	○	○	○
Monitor class progress	○	○	○
Inform instructional decisions	○	○	○
Guide student grouping assignments	○	○	○
To reward students	○	○	○
For Student Individualized Education Plans (IEP) meetings/reports or response to intervention (RTI)	○	○	○

How did you use the student progress data?

What professional development would be helpful for you to more effectively use the mathematics software with your students?

How has having access to the mathematics software influenced your teaching?

Describe **any other ways** you have been using any of the data reporting features of the product. Please note any features of the product that you found particularly helpful. Please state **"none"** if you have not been using the data reporting features.

Professional Development (PD)

Teacher Post-Survey

Default Question Block

What is the name of the school district where you teach?

What is the name of the school where you teach?

What is your primary teaching assignment?

For how many years have you been teaching?

How much STEM content do you teach each week?

- ○ None
- ○ Less than 30 minutes a week
- ○ Between 30 minutes and 1 hour a week
- ○ Between 1 hour and 5 hours a week
- ○ More than 5 hours a week

What is your preferred form of professional development?

Approximately how many hours of your preferred form of professional development did you engage in this year?

Rate your level of knowledge of the Edivate professional development videos project.

- ○ None at all
- ○ A little
- ○ A moderate amount
- ○ A lot
- ○ A great deal

How often have you accessed the Edivate videos for professional development over the last year?

- ◯ Never
- ◯ Logged on but did not watch any videos
- ◯ Watched less than 5 minutes
- ◯ Between 5 and 10 minutes
- ◯ Between 10 and 30 minutes
- ◯ Between 30 minutes and 60 minutes
- ◯ More than 60 minutes

How much do you think that the Edivate professional development videos could or do enhance your teaching effectiveness?

- ◯ Not at All
- ◯ Very little
- ◯ Some
- ◯ A fair amount
- ◯ Significantly

Why do you think the Edivate professional development videos are or are not useful for enhancing your teaching effectiveness?

What is your motivation FOR watching or NOT watching the Edivate professional development videos?

If you do watch the Edivate professional development videos who do you watch them with and what is your goal when you watch them?

What has been the expected outcome for watching the Edivate professional development videos? Do you feel the videos helped you achieve this outcome?

What do you think is the most effective way to use the Edivate professional development videos?

Rate the level you think that watching Edivate professional development videos is useful professional development?

- Not at all useful
- Slightly useful
- Moderately useful
- Very useful
- Extremely useful

What content do you most commonly access (or should be accessed) in the Edivate professional development videos?

How much support do you receive from your principal to engage with the Edivate professional development videos?

- None at all
- A little
- A moderate amount
- A lot
- A great deal

How would you rate your preparation to use the Edivate professional development videos?

- Terrible
- Poor
- Average
- Good
- Excellent

What is the approximate number of minutes you have watched the Edivate videos this year?

- 0 (I have not watched them)
- A few minutes (i looked at them once)
- A few minutes each month
- A few minutes each week
- A few minutes daily

Administrators Post-Survey

Default Question Block

What is the name of the school where you are the principal?

In what district do you work as a principal?

Rate your knowledge of the Edivate Video Professional Development program.

- None
- Very little
- Some
- A great amount
- Expert

Do you think that the Edivate Video Professional Development program is making a difference in your teachers' STEM teaching? If yes - why - and if no - why not.

How should the Edivate Video Professional Development program be used to improve teacher practice?

Have your teachers been prepared to effectively use the Edivate Video Professional Development program?

- Definitely not
- Very little
- Some what
- For the most part
- Definitely yes

Approximately how often do you discuss using the Edivate Video Professional Development program with your teachers?

- I don't
- 1 time a year
- 1 time a semester
- Quarterly
- Monthly
- Weekly
- Multiple times a week

How do you suggest that your teachers use the Edivate Video Professional

Development program?

How much do your teachers find the Edivate Video Professional Development program to be useful?

- Not at all
- Very little
- Somewhat
- A great amount
- A substantial amount

What is your preferred format for providing teachers professional development and why is this your preference?

Powered by Qualtrics

Career and Technical Education (CTE)

Teacher Post-Survey

Utah Governor's Office *of* Economic Development

STEM Action Center

Grade 7 & 8 CTE Teacher Survey

Default Question Block

What is the name of your School?

What is the name of your District?

What CTE product did your school select as part of a grant through the STEM Action Center?

- Project Lead The Way
- Pitsco
- STEM Academy
- International Technology and Engineering Educators Association (ITEEA)

1 of 5

At what grade level is the CTE product currently being used?

- 7th Grade
- 8th Grade
- Both Grades

In what type of class or program did you implement the CTE product?

What is the average number of students in your CTE class(es)?

How well did the CTE product align with your course objective?

- Not at all
- Very little
- Somewhat
- A good amount
- Exactly

Approximately long in terms of days/months have you used the CTE product with students?

About how many students did you use the CTE product with?

How would you rate the effectiveness of the professional development for preparing you to use the CTE product?

- Not at all
- Very lIttle
- Somewhat
- A good amount
- Extremely

Please share some of your personal views about and experiences with the CTE product professional development and ongoing implementation support.

What ongoing professional development would be helpful for your continued CTE product use.

Please share how the CTE product MET or DID NOT MEET your expectations.

How satisfied are you with the CTE product selected for your school?

- Not satisfied
- Somewhat satisfied
- Satisfied
- Very satisfied
- Extremely satisfied

How has the use of the CTE product influenced your level of engagement with other STEM educators (such as learning together)?

How has the product changed your students' level of engagement in your class?

- None at all
- A little
- A moderate amount
- A lot
- A great deal

How likely are you to recommend the CT product to other teachers?

- Not at all
- Very unlikley
- Somewhat likely
- Very likely
- Extremely likely

What do you find to be the most attractive features of the CTE product?

After the end of the program (end of 2015-16 school year) what are your plans for the ongoing use of the CTE product?

Overall how has the use of the CTE product influenced your students' knowledge, behavior, and skill development?

Appendix E – Evaluation Team

Principle Investigator

Michael Snyder, M.S.

Michael Snyder is Research Scientist at Utah State University. He has broad experience in education including over 5 years teaching experience in STEM subjects at USU and public schools. He has over 10 years' experience managing large projects and has worked extensively with Utah state government agencies. These projects includes needs assessment of Public School Counselors and collaboration with Workforce Services, to study patterns of homelessness throughout the state. In his work with Workforce Services, Michael developed new mathematical and statistical methods to show trends in how individuals experiencing homelessness move throughout the service system. Michael's experience with Utah state agencies, public schools, and in-depth analyses, are needed to understand the interdependencies among the grant programs funded through the Utah STEM Action Center as they are implemented throughout Utah.

Support Team

Kyle Eager

Kyle Eagar is finishing a Masters in Statistics and Economics at Utah State University and is scheduled to graduate fall of 2016. Kyle's main research emphasis has been investigating whether famer's mitigate the adverse effects of drought by switching to less water intensive crops. While working as a research assistant in the Applied Economics Department, Kyle has assisted in variety of natural resource and environmental economics projects including; the impact of groundwater management districts on land prices in Western Kansas, the political economy of individual transfer quotes in Alaska, and the impact of changes in the EU Emissions Trading System on corporate stock prices.

Kevin Lawanto

Kevin Lawanto holds a Master of Science degree in Instructional Technology and Learning Sciences, as well as a Bachelor of Science degree in Psychology from Utah State University. Kevin's research interests include neuroscience, assessment, cognition and metacognition, and game-based learning. His Master's Thesis focuses on understanding the development of computational thinking as students learn to program in Scratch, an application developed by MIT and used by students all over the world. During his graduate and undergraduate studies, he has authored and coauthored two book chapters, five journal papers and several posters presentations in reputed international journals and conferences. Currently, he is working as a program evaluator in the Psychology department at Utah State University.

Steph Juth

Stephanie Juth is currently a Ph.D. student at Utah State University studying Literacy Education and Leadership on a *Presidential Doctoral Research Fellowship. S*tephanie has taught secondary science and language arts and served in administrative roles for 17 years. Currently, her research interests include educational neuroscience utilizing eye tracking technologies and fNIRS. Specifically, her research involves exploring reading comprehension, syntactic complexity, and expository reading comprehension across digital ill-structured domains.

Trevor Williams

Trevor Williams is a Master's student at Utah State University. He holds a Bachelor's degree in Mathematics Education and has many years of experience teaching STEM subjects at all levels. His current research interests are in undergraduate mathematics education and combinatorial game theory. He has presented his research at numerous regional and national conferences.

Acknowledgements

The evaluation team would like to acknowledge the help and support of a number of people and institutions that facilitated the completion of this report. David Joy consulted on numerous sections of this report. Emma Bullock consulted on the Professional Development section of the report. Jamison Fargo provided administrative support. The Utah State University Statistical Consulting Studio provided feedback and advice on statistical analyses. Analysis of SAGE scores for the K-12 section of the report was provided by Analytica Inc. Utah State University provided facilities and other resources to the support team. Thank you very much.

Appendix F – SAGE Analysis Comparison Tables

The following tables provide a comparison of demographic characteristics between the full SAGE assessment data set and the data set resulting from the propensity score matching procedure. With the exception of those products for which there was not a large enough sample, each of the three comparisons used in the logistic regression analysis were included. For completeness, we included the demographic proportions for the full SAGE assessment data for all products, including those excluded from the regression analysis.

Aleks												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	37.98%	35.50%	32.70%	36.70%	37.98%	48.60%	48.10%	31.80%	48.60%	35.50%	37.90%	47.30%
SPED	8.65%	12.42%	9.50%	8.30%	8.65%	15.10%	14.00%	4.50%	15.10%	12.42%	14.00%	14.80%
ELL	3.13%	4.53%	3.00%	2.50%	3.13%	6.00%	5.10%	1.10%	6.00%	4.53%	4.60%	4.80%
White	78.79%	74.83%	77.00%	79.90%	78.79%	71.70%	70.90%	85.30%	71.70%	74.83%	73.40%	73.20%
Hispanic	15.14%	16.82%	15.30%	14.30%	15.14%	20.00%	21.70%	10.00%	20.00%	16.82%	18.00%	19.80%
Male	48.63%	51.55%	51.40%	48.50%	48.63%	53.40%	53.80%	48.50%	53.40%	51.55%	51.80%	53.40%
Proficient ELA	49.97%	45.61%	49.60%	50.70%	49.97%	36.22%	35.60%	66.30%	36.22%	45.61%	39.50%	36.90%
Proficient Math	49.52%	46.07%	50.40%	50.40%	49.52%	36.93%	36.10%	73.40%	36.93%	46.07%	37.90%	37.90%

Table 78. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups.

Catch Up Math												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C

Low Income	NA	NA	NA	NA	NA	NA	NA	NA	15.84%	35.50%	15.20%	15.20%
SPED	NA	NA	NA	NA	NA	NA	NA	NA	6.44%	12.42%	2.20%	2.20%
ELL	NA	NA	NA	NA	NA	NA	NA	NA	0.99%	4.53%	0.00%	0.00%
White	NA	NA	NA	NA	NA	NA	NA	NA	81.19%	74.83%	82.00%	82.00%
Hispanic	NA	NA	NA	NA	NA	NA	NA	NA	13.37%	16.82%	10.70%	12.40%
Male	NA	NA	NA	NA	NA	NA	NA	NA	49.01%	51.55%	48.30%	48.30%
Proficient ELA	NA	NA	NA	NA	NA	NA	NA	NA	65.79%	45.61%	68.50%	68.50%
Proficient Math	NA	NA	NA	NA	NA	NA	NA	NA	57.59%	46.07%	60.70%	60.70%

Table 79. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups. Each column of NAs means a comparison was not made due to small sample size, or lack of data for one of the three comparison groups.

Edready												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	0.00%	35.50%	NA	NA	0.00%	11.11%	NA	NA	11.11%	35.50%	NA	NA
SPED	5.26%	12.42%	NA	NA	5.26%	11.11%	NA	NA	11.11%	12.42%	NA	NA
ELL	0.00%	4.53%	NA	NA	0.00%	0.00%	NA	NA	0.00%	4.53%	NA	NA
White	94.74%	74.83%	NA	NA	94.74%	100.00%	NA	NA	100.00%	74.83%	NA	NA
Hispanic	5.26%	16.82%	NA	NA	5.26%	0.00%	NA	NA	0.00%	16.82%	NA	NA
Male	42.11%	51.55%	NA	NA	42.11%	66.67%	NA	NA	66.67%	51.55%	NA	NA
Proficient ELA	41.18%	45.61%	NA	NA	41.18%	33.33%	NA	NA	33.33%	45.61%	NA	NA
Proficient Math	20.00%	46.07%	NA	NA	20.00%	16.67%	NA	NA	16.67%	46.07%	NA	NA

Table 80. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set. Each column of NAs means a comparison was not made due to small sample size, or lack of data for one of the three comparison groups.

iready												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	44.90%	35.50%	NA	NA	44.90%	35.50%	NA	NA	36.65%	35.50%	NA	NA
SPED	9.69%	12.42%	NA	NA	9.69%	12.42%	NA	NA	12.08%	12.42%	NA	NA
ELL	1.53%	4.53%	NA	NA	1.53%	4.53%	NA	NA	1.45%	4.53%	NA	NA
White		74.83%	NA	NA		74.83%	NA	NA	89.55%	74.83%	NA	NA
Hispanic	6.73%	16.82%	NA	NA	6.73%	16.82%	NA	NA	5.66%	16.82%	NA	NA
Male	53.06%	51.55%	NA	NA	53.06%	51.55%	NA	NA	52.40%	51.55%	NA	NA
Proficient ELA	45.05%	45.61%	NA	NA	45.05%	45.61%	NA	NA	48.17%	45.61%	NA	NA
Proficient Math	48.63%	46.07%	NA	NA	48.63%	46.07%	NA	NA	52.63%	46.07%	NA	NA

Table 81. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set. Each column of NAs means a comparison was not made due to small sample size, or lack of data for one of the three comparison groups.

MathXL		
	High Fidelity vs Unfunded	
Charcteristic	T	C
Low Income	44.90%	35.50%
SPED	9.69%	12.42%
ELL	1.53%	4.53%
White		74.83%
Hispanic	6.73%	16.82%
Male	53.06%	51.55%
Proficient ELA	45.05%	45.61%
Proficient Math	48.63%	46.07%

Table 82. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set. Fidelity data was not provided by Math XL, hence there could be not comparison.

Reflex												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	44.35%	35.50%	42.60%	42.60%	39.04%	44.35%	38.90%	47.10%	39.04%	35.50%	38.20%	38.20%
SPED	16.43%	12.42%	13.90%	13.90%	9.89%	16.43%	5.80%	16.40%	9.89%	12.42%	6.90%	6.90%
ELL	6.98%	4.53%	5.70%	5.70%	6.68%	6.98%	6.80%	7.20%	6.68%	4.53%	6.90%	6.90%
White	66.32%	74.83%	67.20%	67.20%	65.78%	66.32%	65.50%	66.20%	65.78%	74.83%	65.10%	65.10%
Hispanic	23.20%	16.82%	22.50%	22.50%	26.20%	23.20%	27.00%	24.20%	26.20%	16.82%	27.30%	27.30%
Male	51.75%	51.55%	51.20%	51.20%	50.80%	51.75%	48.80%	50.50%	50.80%	51.55%	52.60%	49.30%
Proficient ELA	35.70%	45.61%	39.30%	39.30%	41.31%	35.70%	44.80%	31.10%	41.31%	45.61%	43.50%	43.50%
Proficient Math	32.26%	46.07%	35.40%	35.40%	39.60%	32.26%	43.00%	19.10%	39.60%	46.07%	41.80%	41.80%

Table 83. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups.

ST Math												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	64.36%	35.50%	65.10%	65.20%	64.36%	45.69%	63.80%	65.20%	45.69%	35.50%	45.50%	45.50%
SPED	15.96%	12.42%	16.00%	16.00%	15.96%	13.67%	14.50%	16.00%	13.67%	12.42%	12.70%	13.40%
ELL	13.41%	4.53%	11.30%	11.40%	13.41%	6.57%	10.40%	11.40%	6.57%	4.53%	6.10%	6.10%
White	43.59%	74.83%	43.20%	43.20%	43.59%	62.38%	45.90%	43.20%	62.38%	74.83%	62.20%	62.20%
Hispanic	39.36%	16.82%	41.50%	41.50%	39.36%	24.41%	38.00%	41.50%	24.41%	16.82%	25.00%	25.00%

Male	52.62%	51.55%	52.00%	51.80%	52.62%	49.02%	50.70%	51.80%	49.02%	51.55%	48.70%	48.70%
Proficient ELA	39.21%	45.61%	38.40%	38.40%	39.21%	45.95%	38.70%	38.40%	45.95%	45.61%	47.70%	46.40%
Proficient Math	32.26%	46.07%	35.40%	35.40%	39.60%	32.26%	43.00%	19.10%	39.60%	46.07%	41.80%	41.80%

Table 84. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups.

SuccessMaker												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	38.97%	35.50%	34.80%	38.40%	NA	NA	NA	NA	NA	NA	NA	NA
SPED	13.45%	12.42%	14.70%	13.60%	NA	NA	NA	NA	NA	NA	NA	NA
ELL	0%	4.53%	0.00%	0.00%	NA	NA	NA	NA	NA	NA	NA	NA
White	92.76%	74.83%	92.80%	92.80%	NA	NA	NA	NA	NA	NA	NA	NA
Hispanic	3.79%	16.82%	3.90%	3.90%	NA	NA	NA	NA	NA	NA	NA	NA
Male	56.55%	51.55%	56.30%	56.30%	NA	NA	NA	NA	NA	NA	NA	NA
Proficient ELA	47.31%	45.61%	47.30%	47.30%	NA	NA	NA	NA	NA	NA	NA	NA
Proficient Math	55.52%	46.07%	55.20%	55.20%	NA	NA	NA	NA	NA	NA	NA	NA

Table 85. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups. Each column of NAs means a comparison was not made due to small sample size, or lack of data for one of the three comparison groups.

Think Through Math												
	High Fidelity vs Unfunded				High Fidelity vs Low Fidelity				Low Fidelity vs Unfunded			
Charcteristic	T	C	Matched T	Matched C	T	C	Matched T	Matched C	T	C	Matched T	Matched C
Low Income	23.98%	35.50%	23.80%	23.80%	23.98%	42.15%	22.90%	23.80%	42.15%	35.50%	37.40%	41.60%

SPED	4.17%	12.42%	4.10%	4.10%	4.17%	15.31%	3.90%	4.10%	15.31%	12.42%	13.40%	14.70%
ELL	0.55%	4.53%	0.30%	0.30%	0.55%	5.03%	0.40%	0.30%	5.03%	4.53%	4.50%	4.50%
White	88.34%	74.83%	88.80%	88.90%	88.34%	74.19%	89.30%	88.90%	74.19%	74.83%	74.50%	74.90%
Hispanic	5.73%	16.82%	5.60%	5.50%	5.73%	17.50%	5.20%	5.50%	17.50%	16.82%	17.60%	17.60%
Male	48.27%	51.55%	48.20%	48.20%	48.27%	51.91%	49.20%	48.20%	51.91%	51.55%	52.30%	52.10%
Proficient ELA	65.74%	45.61%	65.80%	65.80%	65.74%	39.87%	62.20%	65.80%	39.87%	45.61%	42.50%	40.10%
Proficient Math	68.22%	46.07%	68.30%	68.30%	68.22%	41.33%	65.00%	68.30%	41.33%	46.07%	41.80%	41.80%

Table 86. This table gives the proportion of students with the specified demographic characteristics for the treatment (T) and comparison (C) groups for the full SAGE data set and the propensity score matched comparison groups.