STEM Action Center
Annual Report to the Education Interim Committee
September 17, 2014

The following report is being submitted to Education Interim Committee by the STEM Action Center. The report contains the following requested information:

(1) The Board shall report the progress of the STEM Action Center, including the information described in Subsection (2), to the following groups once each year:

(2) The report described in Subsection (1) shall include information that demonstrates the effectiveness of the program, including:

(a) the number of educators receiving high quality professional development;

(b) the number of students receiving services from the STEM Action Center;

(c) a list of the providers selected pursuant to this part;

(d) a report on the STEM Action Center's fulfillment of its duties described in Subsection 63M-1-3204; and

(e) student performance of students participating in a STEM Action Center program as collected in Subsection 63M-1-3204(4).

1. The number of educators receiving high quality professional development:
The professional development project is underway and the STEM AC, in partnership with the USOE, the School Improvement Network and Scholastic FSM, are currently working to solicit license requests from districts and charter schools. The application deadline for license requests is September 19th and deployment of the professional development to those educators will be deployed immediately after the application deadline. The STEM AC will be able to report the total number of educators that will be receiving high quality professional development once the application period is over.

2. The number of students receiving services from the STEM AC

The numbers of students that have or will be receiving services from the STEM AC are as follows:

- camps and competitions: 1,400
- math pilot for middle school and high school technologies: 6,540
- scale up for middle school and high school technologies: 161,256
- K-6 math technologies: 95,431
- the media launch: 50

3. A list of providers selected pursuant to this bill:
See Attachment B

4. A report of the STEM AC fulfillment of its duties described in subsection 63M-1-3204

Per subsection 63M-1-3204:

STEM Action Center (STEM AC) Staff and Roles (63M-1-3204; 1(a), (c)i)
The STEM Action Center (STEM AC) was established in 2013 and consists of the Executive Advisory Board, an Executive Director, Program Manager, Administrative Assistant, Outreach and Engagement Specialist and STEM Specialist that serves as a liaison to the USOE.

Private entity engagement (in addition to what is currently provided by private entities) (63M-1-3204; 1(d); 2 (e))
Private entities have been fully engaged in the media launch , as well as other projects, for the STEM AC. These activities include an assembly that launched the marketing and media campaign on January 30, 2014. Governor Herbert provided the keynote remarks and Stan Ellison from BYU TV's "American Ride" participated in welcoming the students and media. There were numerous corporate partners in attendance including executives from L-3 Communications, Merit Medical, Chevron, eBay and Energy Solutions and the finale was Scott & Brendo who performed a song written specifically for the STEM media launch. Comcast has been working with a number of Utah companies to create media spots that highlight STEM companies; along with portraying the need for STEM talent in Utah. The STEM AC is working with Comcast to launch the second phase of the media campaign which is now intended to move from a high level of "changing hearts and minds" to real

engagement with students and schools. A full-page description of the STEM Investors Coalition is included as Attachment A.

Corporate partners have been engaged in additional activities that include

- JPMorgan provided a $50,000 grant to the Utah Afterschool Network, in partnership with the STEM AC. This grant will support a statewide study on the status and quality of STEM-based after school programs. An outcome of this grant will be to identify criteria that define a high quality STEM after school program.
- Adobe organized and hosted an Un-Conference for the STEM AC and the STEM community
- Goldman-Sachs and the Salt Lake Real are sponsoring a corporate soccer tournament as a fund raiser for the STEM AC
- Companies and professionals from STEM-related companies participated in a 3-day career awareness pilot for STEM educators; this included visits to companies and company professionals participating in small group roundtables with educators for one of the three days.
- Utah companies are working together to plan a three-day STEM festival on March 26-28, 2015. This statewide STEM festival will showcase Utah companies with engaging hands on activities and demonstrations.
- PluralSight donated $5M in licenses for educators to access during the 2014-2015 school year
- An additional $32,000 (independent of the STEM Investors Coalition) was donated directly to the STEM AC by various corporate sponsors

R&D role of STEM AC (63M-1-3204; 2 (a)- (c); (f))
The STEM AC serves as a third party to conduct R&D projects in key areas of STEM education. The projects funded in HB139 and HB 150 include (1) implementation of best practice math technologies in K-12 classrooms with an emphasis on college and career readiness in math for high school (2) implementation of video-based, online professional development tools and materials (3) design and implementation of an elementary STEM endorsement (4) implementation of products and materials with the necessary professional development to improve applied science and technology in 7th and 8th grade Career and Technical Education courses and (5) implementation of high school STEM certifications that are industry-recognized and facilitate employment in available STEM careers.

63M-1-3204 2 (c) - A core function of the STEM AC, that is a critical component of the R&D process, is the review of STEM education-related materials and products. The STEM AC has reviewed and facilitated the use of materials and products for K-12 math software, applied STEM materials, and video-based online tools for professional development. See Attachment B for a full list of vendor-based products that were selected for these various projects.

63M-1-3204 2 (f) - The STEM AC focuses on using resources to bring the latest STEM education learning tools into public education classrooms. This can be seen with the implementation of math digital learning tools in K-12 classrooms. These tools infuse the use of technology to support the improvement of math skills for students and better prepare students to be successful in post-secondary STEM-related programs. The STEM AC is working to implement materials and products that facilitate hands on, project-based learning activities for 7th and 8th grade Career and Technical Education (CTE) courses.

Support of STEM-related competitions, fairs and camps, and STEM education activities (63M-1-3204; 2 (d))

The STEM Action Center helped to increase student participation in fairs, camps and competitions to support STEM education and economic growth in Utah. Our office supported students by awarding $220,000 in post-performance grants to K-12 students who detailed their participation in any STEM fair, camp or competition. Approximately 1,400 students were impacted this year and the Center reached students from over 80 different Utah schools.

Identification of best practices being used outside the state and learning tools for K-12 classrooms (63M-1-3204 2 (h and i) i- and ii))

63M-1-3204 (h) - We have attended various conferences including the US World and News STEM conference and the Midwest States STEM Initiative Forum. There were several innovative practices that have been working well for other states including an incentive plan for districts to more effectively recruit and retain students in key STEM areas of Career and Technical Education (CTE; Kansas), a media campaign that has been very effective in changing the attitudes of the general public towards STEM (Iowa), transformation of schools and districts into high performing STEM schools and districts (Tennessee and Colorado).

Provide a Utah best practices database (63M-1-3204, 2 (j))

The Curiosity Unleashed (STEM.utah.gov) website provides access to content that targets students, parents, educators and industry partners. The content consists of innovative STEM materials for use in the classroom and at home. These materials range from audio and video-based content to links that showcase best practices by Utah STEM stakeholders as well as materials that are hosted by other high quality websites. The content includes information that showcases the variety of career options, the educational pathways and the Utah professionals that represent these STEM career choices. The site includes information regarding STEM events and activities across the State; a description of these events, along with dates, locations and a point of contact will be included and the events are posted monthly on a calendar. This content is presented as a searchable library that allows a user to find resources of interest. Contests for students will be hosted, in partnership with industry partners that allow students to provide input to the website and become more involved in STEM. Finally, a unique function is currently being developed that will provide a mechanism to link industry partners to classrooms. Industry partners will complete a profile of their company and the resources that they are able to provide (e.g., guest speakers, field trips, assembly demonstrations, internships, job shadows,

scholarships, access to mentors etc.). An educator, student or parent can submit a query looking for specific resources (e.g., a guest speaker in biomedical engineering), which will then be matched to the right company that is a good match for that resource request.

63M-1-3204 2 (k) i and ii – To date a tracking mechanism for this type of information has not been included. This can be added in phase two of the website development.

Join and participate in a national STEM network (63M-1-3204 2(l))
The STEM AC joined STEMConnector for one year as a pilot. STEMConnector is a national organization that supports the STEM community nationally, as well as regional and state initiatives. They provide significant national exposure and coverage of STEM activities and they provide programs that facilitate national and regional dialogue. The STEM AC has been invited to participate in several programs including the Computer Science and Engineering Roundtable in New York City and the STEM Roundtable event for leveraging industry partnerships. The STEM AC is in discussion with STEMConnector to plan for a legislative roundtable that will be hosted by the STEM AC in Salt Lake City.

Identify performance changes linked to use of the best practices database (63M-1-3204 2 (m))
The STEM AC has not actively collected any usage and customer satisfaction data for the website at this time. It is the intent of the Center to begin collecting this information in September 2014 with the official launch of the 2.0 version of the website which is more complete with content.

STEM school designation (63M-1-3204, 2 (n))
The STEM AC, working with the USOE, has established a set of criteria that defines a STEM school. The SBOE and the STEM AC Executive Board have approved the criteria. A description of the criteria is included as Attachment C.

Support best methods of high quality professional development for K-12 STEM Education (63M-1-3204 2 (o))
The STEM AC is working collaboratively with the USOE to design and deploy a professional development project to school districts and charter schools to implement best practice tools for video-based, online professional development products. Two products were reviewed and approved through a state-approved procurement process. Districts and charter schools will have the opportunity to review these products and submit a request for licenses and the additional support of implementation, if needed. The two products selected were Scholastic and School Improvement Network. The product providers will create videos that feature best practices in STEM education from Utah educators. License requests are due Sept 19th and vendors will be able to begin immediate implementation with their districts.

Recognize a high schools achievement in the STEM competitions, fairs and camps (63M-1-3204, 2 (p))

63M-1-3204 2 (p) - The STEM AC has compiled a list of winners from STEM competitions (e.g., Science Olympiad, FIRST robotics), fairs (regional and national science fairs) and outstanding camps that excel in various aspects of STEM (participation, innovation, impact on underserved or at risk populations) and has begun to highlight these "shining stars" on our website. There will be additional opportunities to showcase students and events in the next phase of the media campaign that is being deployed in partnership with Comcast and other various industry partners.

Send student results from STEM competitions, fairs and camps to media and ask the media to report on them (63M-1-3204 2 (q))

The STEM AC has worked closely with media partners to showcase STEM activities in general. To date there have been no specific competition or fair winners that the STEM AC has asked the media to cover.

Develop and distribute STEM information to parents of students being served by the STEM AC (63M-1-3204, 2 (r))

The STEM AC has (or will be) participating in the following STEM activities to distribute information to parents: a booth at ComiCon, STEM AC team members are organizing STEM activities for two full days at the 2014 State Fair.
The STEM AC is partnering with AmeriCorp and the Boys and Girls Club of Utah to launch a new outreach program as a pilot in Provo School District. Twenty AmeriCorp volunteers will be placed in 20 different junior high schools and trained to conduct daily STEM activities. The STEM AC will support the project by bringing together stakeholders to help design engaging, hands on activities, give guest presentations (e.g., local athletes, cool scientist, journalists etc.) which will be taped and disseminated to a larger audience and posted on the STEM AC website. The intent is to design this program as a replicable and scalable model, if it proves to be a best practice.

Support targeted high quality professional development for improved instruction in education, including improved instructional materials that are dynamic and engaging and the use of applied instruction (63M-1-3204, 2(s) i - iii)

The STEM AC is overseeing three projects that address high quality professional development for the improvement of hands on, applied and engaging instruction materials. The STEM AC is working in partnership with the Career and Technical Education (CTE) staff at the USOE to select and implement new materials and classroom tools into 7th grade Introduction to CTE and 8th grade Exploring Technology. These tools will focus on computer sciences and programming, information technology and engineering. The vendors selected through the state procurement process will be announced at the end of September.

The STEM AC is working in partnership with the math and science specialists at the USOE, as well as partners in higher education, to design and implement a new elementary STEM endorsement. This endorsement will consist of a sequence of six courses that will provide elementary educators with a more in depth understanding of critical STEM topics and innovative ways to implement applied or hands on instruction in their classrooms. The committee that has been working on this endorsement has put attention to topic and instructional methodologies that are missing in the current educational "portfolio" of elementary educators (e.g., the use of technology or engineering-based applications for science and math).

Finally, the STEM AC is working with the USOE and selected product providers (see description of products that were selected for use in this project in the attached documents, Attachment B) to deploy video-based, online professional development tools for K-12 STEM educators. School districts and charter schools are currently reviewing the selected products and determining which product they will deploy and how many licenses they will request.

Ensure that an online college readiness assessment tool be accessible by public education students and higher education students. (63M-1-3204, 2 (t) i and ii))
The STEM AC, working in partnership with the USOE and Utah Education Network, is providing online access to EdReady for all Utah students. EdReady is, an online college and career readiness tool which allows a student to select which college they are considering to attend and then provides a test for the student that indicates if they are at performance levels in math to meet admission requirements. The EdReady tool gives them access to developmental math curriculum online that allows the student to improve in areas that have been identified as deficient for admission.

The Board may prescribe other duties for the STEM AC in addition to the responsibilities described in this section (63M-1-3204, 3)

The STEM AC has been involved in additional activities that include partnering with the Utah Department of Workforce Services (DWS) to support programmatic design and review of grants for STEM related grant programs that target economically disadvantaged students. The grants required applicants to identify how they would identify and recruit economically disadvantaged students to their respective program. The DWS was the fiscal and program lead with the STEM AC providing support to solicit and review proposals. The STEM AC will also support monitoring and evaluation input for the grants. The grants focused on K-12 in school STEM programming and 7-12 after school programming. There were 17 in school grants and 13 after school grants funded. The proposals were awarded to districts, schools and community partners across the entire state. They targeted areas of STEM that ranged from engagement and recruitment to providing alignment of educational programs to workforce needs.

Acquisition of STEM education related instructional technology program – Research and development of education related instructional technology through a pilot program (63M-1-3205)

The STEM AC conducted a 4-month pilot (September through December 2013) to test various middle and high school instructional technologies for math. A summary of the findings is can be found in a report included as Attachment D. In summary, the pilot demonstrated the following:

Summary of Findings:

- ✓ Students in the pilot (Oct-May 2014) using ALEKS, Think Through Math, ST Math, Math 180, and EdReady made more progress in mathematics than would be expected under normal condition in a full academic year.
- ✓ There was a slight decrease in usage in the spring due to the need to use computers for the state SAGE assessment.
- ✓ Teachers continue to report satisfaction with the digital mathematics technologies. There was a decrease in students' perceptions about mathematics.
- ✓ There is a need to find ways to further engage students in mathematics, such as opportunities to experience applied mathematics activities.

The STEM AC is now in the process of scaling the middle and high school pilot to a statewide implementation. The results for licenses requested are show in the following tables.

Middle School	Licenses Awarded	Total Number of Utah Middle School Students (grades 6-8)	Percentage of Students Reached
ALEKS	48,686		
Compass Learning	290		
Curriculum Associates	7,230		
Explore Learning	2,128		
Hot Math	701		
MIND	4,319		
Think Through Math	15,338		
TOTAL	**78,692**	**140,565**	**56%**

High School	Licenses Awarded	Total Number of Utah High School Students (grades 9-12)	Percentage of Students Reached
ALEKS	68,352		
NROC	1,009		
Hot Math	2,037		

Pearson	8,113		
Carnegie	841		
Think Through Math	2,212		
TOTAL	**82,564**	**173,220**	**48%**

The STEM AC is in the process of deploying a similar instructional technology program for math that is targeted to K-6 students. The requests for student access to licenses are in the following table.

K-6	Licenses Requested	Total Number of Utah K-6 Students (grades K-6)	Percentage of Students Reached
ALEKS	32,083		
Pearson	2,030		
Curriculum Associates	23,367		
MIND	29,970		
Think Through Math	7,981		
Total	**95,431**	**345,967**	**28%**

It is important to note that a pilot was not used for deployment of the K-6 instructional technologies to expedite implementation. The vendors selected for the statewide implementation of both the middle and high school and K-6 math technologies are provided in Attachment B. The vendors for all technologies are working currently with K-12 educators to implement the technologies.

Report on student performance of students participating in a STEM Action Center program as collected in Subsection 63M-1-3204(4).

A description of the activities that relate to tracking student performance of student participants in STEM programs is included as Attachment E.

ATTACHMENTS:

Attachment A: Report for STEM Investors Coalition

Attachment B: Selected vendor list

Attachment C: Criteria for STEM school designation

Attachment D: evaluation report for the middle and high school math pilot

Attachment E: Report on student performance

Industry Coalition Report
STEM Action Center Support **September 3, 2014**

The STEM Utah Industry Coalition currently consists of 21 companies and organizations. This group has contributed/pledged over $2.3 Million in cash, products and services to promote STEM education and further the work of the STEM Action Center since it came together in January 2014.

- IM Flash
- Goldman Sachs
- Chevron
- Fidelity
- Rocky Mountain Power
- Utah Career Center – Labor Unions
- Merit Medical
- doTERRA
- U.S. Synthetic
- Dept. Workforce Services
- Utah Technology Council
- Comcast
- NuSkin
- Nelson Labs
- Energy Solutions
- Regents Blue Cross
- ATK
- KUTV
- EMC2
- Energy Solutions
- L-3 Communications

The following is a summary of this effort:

• Cash contributions to-date:	$804,750
• Cash pledged through Q2/2015	$405,000
• In-Kind contributions	
○ TV & Online media	$695,214
○ News stories (value)	$354,710
○ TV Production, Events & Services	$ 72,092
Total……	**$2,331,766**

Media summary – Jan 29 – Aug 30, 2014:

• TV spots…Cable networks, KUTV & KMYU	7,848
• Online video ad impressions	2,508,547
• News stories on broadcast TV & live event coverage	52

Attachment B

HB Project	Vendor	Alignment
Math Software: Grades 6-12	McGraw Hill (ALEKS)	✓ Contains individualized instructional support for skills and understanding of core standards ✓ Is self-adapting to respond to the needs and progress of the learner ✓ Provides opportunities for frequent, quick and informal assessments ✓ Includes an embedded progress monitoring tools and mechanisms for regular feedback to students and teachers
Math Software: Grades 6-12	Pearson (MathXL)	
Math Software: Grades 6-12	Think Through Math	
Math Software: Grades 6-12	Explore Learning (Reflex)	
Math Software: Grades 6-12	Compass Learning (Odessey)	
Math Software: Grades 6-12	Hot Math (Catchup)	
Math Software: Grades 6-12	MIND (ST Math)	
Math Software: Grades 6-12	Curriculum Associates (i-Ready)	
Math Software: Grades 6-12	Monterey (NROC)	
Math Software: Grades K-6	McGraw Hill (ALEKS)	✓ Contains individualized instructional support for skills and understanding of core standards ✓ Is self-adapting to respond to the needs and progress of the learner ✓ Provides opportunities for frequent, quick and informal assessments ✓ Includes an embedded progress monitoring tools and mechanisms for regular feedback to students and teachers
Math Software: Grades K-6	Pearson (MathXL)	
Math Software: Grades K-6	MIND (ST Math)	
Math Software: Grades K-6	Think Through Math	
Math Software: Grades K-6	Curriculum Associates (i-Ready)	
Professional Development Software	Scholastic	✓ Access to automatic tools, resources and strategies ✓ Work in online learning communities ✓ Includes video examples of highly effective STEM education teaching
Professional Development Software	School Improvement Network	

		✓ Covers a cross section of grade levels and subjects ✓ Includes videos of Utah STEM educators ✓ Contains tools to help implement what has been learned ✓ Allowance for face-to-face learning in a hybrid model
Career and Technical Education Software: Grades 7 & 8	Vendor selection is not finalized	

MEMORANDUM

TO: Members, Utah State Board of Education

FROM: Martell Menlove, Ph.D.
Chief Executive Officer

DATE: August 8, 2014

ACTION: STEM Schools

Background:
H. B. 150 *Science, Technology, Engineering, and Math Amendments*, 2014 State Legislative Session, called for the STEM Action Center to work cooperatively with the State Board of Education to designate schools as STEM schools, where the schools have agreed to adopt a plan of STEM implementation in alignment with criteria set by the State Board of Education and the STEM Action Center Board.

Key Points:
The State Board of Education and the STEM Action Center Board need to designate the criteria for schools to adopt a plan of STEM Implementation.

Anticipated Action:
Teaching and Learning staff will present a proposal for the Board of Education to consider in collaboration with the STEM Action Center Board.

Contact: Brenda Hales, 801-538-7515
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Diana Suddreth, 801-538-7794
Mitchell Jorgensen, 801-538-7959

Utah STATE OFFICE of Education

Proposed Criteria for Becoming a USOE/STEM Action Center Identified STEM School

August 8, 2014

Science, technology, engineering and math (STEM) education is best sustained by supporting both individual content areas and integrated experiences. Mathematics and science build the foundation for students to apply learning in technology and engineering coursework. In turn, technology and engineering process support learning and application of science and mathematics. Integrated coursework and projects can be used to support both the academic core standards and the career and technical program standards. Furthermore, all four work together as students engage in design challenges, laboratory experiences, and internships with rapidly growing STEM companies. STEM education requires an integrated learning approach where engineering is valued as more than activities in academic courses, where technology is seamlessly integrated throughout, and where there are high expectations for achievement in mathematics and science.

In order to support local initiatives that are attempting to meet the requirements of STEM education in Utah, the Utah Legislature is supporting designation of STEM schools. Utah Code 63M-1-3204 States in part that:

> *"The STEM Action Center as funding allows shall: work cooperatively with the State Board of Education to designate schools as STEM schools, where the schools have agreed to adopt a plan of STEM implementation in alignment with criteria set by the State Board of Education and the board;"*

The following criteria are proposed to be used to evaluate STEM schools. These criteria are based on similar statewide efforts in Texas, North Carolina and the highly successful Utah Dual Immersion schools.

Proposed criteria for an exemplary STEM School:

1. **Curriculum** - STEM Curriculum is selected based on Utah Core Standards. Curriculum has an articulated interconnectedness between science, technology, engineering and math. Curriculum and instruction is coordinated between the various aspects of STEM. Projects form a substantial part of the curriculum.
2. **Leadership** - Leadership has created clear definitions and a vision of STEM teaching and learning as it applies in the local school and as informed by state, national, and global efforts. Collaboration exists between community, industry and other education partners. Efforts are made to connect to national and global efforts.
3. **Assessment** - Assessments are ongoing, authentic and cross-curricular. They are project-focused and performance-based. Rubrics for projects are provided and articulate with the goals of the assessment. Formative assessment informs summative assessment and teaching efforts.
4. **Professional Learning** – STEM-focused professional learning is fully implemented. Professional development aligns with Utah's requirements for professional learning (Utah Code 53A-3-701) and aligns with Utah Core Standards and Utah Effective Teaching

Standards. Learning communities and learning networks are integrated into efforts for personal growth and school wide growth.

5. **Teaching** - Teaching is conducted with a focus on STEM concepts, processes and thinking. Teachers coordinate lessons, ideas and planning among one another with a mechanism in place for doing so in both formal and informal ways. Incentives exist for supporting one another. Correlations among various aspects of STEM are articulated and explicit. Faculty demonstrates content competency in all areas of STEM and have relevant endorsements. Efforts are made to support content sharing
6. **Student Engagement and Equity** - There is solid evidence for engagement of all demographics in the local community. Efforts are connected and follow a coherent research-based plan. Efforts show a deep understanding of STEM equity issues and needs. Students are regularly involved in planning and conducting learning activities. Students are regularly engaged in the actual doing of science, mathematics and project-based learning.
7. **Community** - There is an established community of practice regarding STEM learning and STEM teaching. Events, activities and opportunities for involvement help students, teachers, parents and community members learn about and support STEM education in the school.
8. **Facilities** - Spaces are available for collaboration and project work. Facilities have been adapted or designed for STEM Learning. Facilities reflect a focus on STEM learning efforts. Facilities reflect student design and input in the use of the facilities. Materials and equipment follow safety protocols. Obvious efforts have been made to make resources available to students for use in learning, design and project efforts.
9. **Strategic Alliances** - Alliances exist between the school and strategic partners. Parents and parent groups are involved in the school process and decision making. Business, industry and other community partners work together to promote STEM learning and career awareness. Long term partnerships are formed and supported through ongoing efforts. Partnerships are evaluated at least annually and additional partnerships are formed to support emerging needs and opportunities. Teachers have ongoing relationships with industry partners and engage in externships.
10. **Advancement and Sustainability** - A five-year plan includes each of the criteria for an effective STEM school. Strengths and weaknesses are identified. Plans are in place to address weaknesses with evidence and research supporting the plan. Strengths are examined for the purpose of continued improvement. Future efforts and trends are examined and ongoing renewal is planned for.

Proposed Process:

- School writes a STEM Schools Plan Document. This should include evidence of their current state and their plans for improving each of the ten criteria.
- A rubric for the above criteria with a scale from 0 (no evidence) to 5 (exemplary) will be used to evaluate the schools.
- A committee made up of members or designees representing the Utah State Board of Education and STEM Action Center Board will evaluate the plans and possibly conduct an onsite visit to verify the status of the schools.

For more information, contact Mitchell Jorgensen at mitchell.jorgensen@schools.utah.gov or 801-538-7959.

STEM Action Center Technology Pilot Assessment

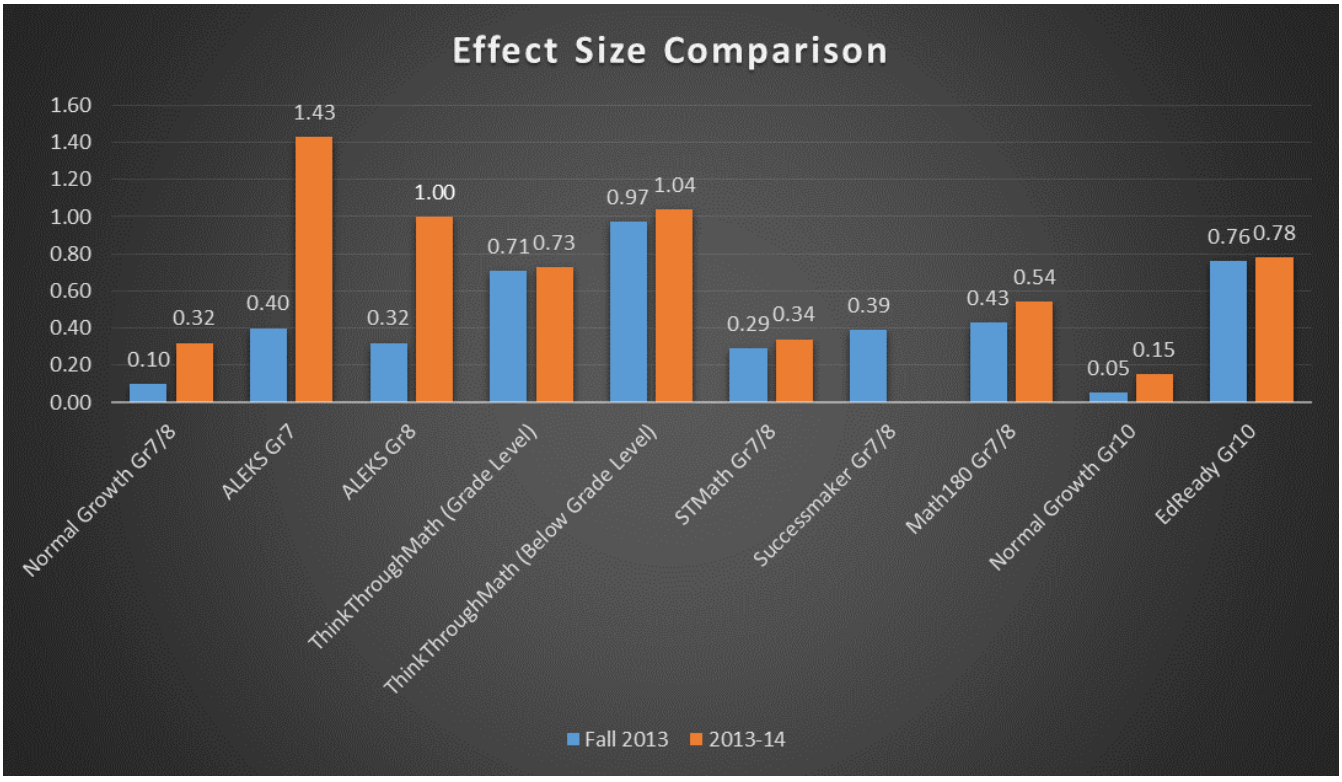
Dr. Taylor Martin and Dr. Sarah Brasiel, Department of Instructional Technology and Learning Sciences, Utah State University

Overview of Assessment Findings for 2013-14 Academic Year

In the 2013 Utah Legislative session, HB 139 was passed which created the STEM Action Center for the State of Utah. This legislation also authorized a pilot program to begin in the 2013-14 school year. The pilot has two components. The first is to provide educational technology to support mathematics instruction for students in grades 6-8. The second is to prepare secondary students for college mathematics courses. The goal of this assessment is to determine the effectiveness of mathematics digital programs implemented in selected schools in Utah during the 2013-14 academic year.

Since each product had its own assessment with its own measurement scale, we standardized the difference between a student's pretest and posttest score, hereafter called a gain score, by creating a standardized mean difference called an *effect size*. The effect size was calculated by dividing the gain score by its standard deviation[1]. Because the effect size for each product assessment is reported in standard deviation units, the effect size for each product assessment can be compared. When just looking at the gain score of students using the product it is important to compare their gain to an accepted benchmark[2] that represents the average gain score. This is expressed as an effect size that would occur under normal school year conditions and without attributing this gain to an intervention. For grades 7 and 8, a student's annual mathematics growth is an effect size of 0.32 standard deviation units. For grade 10 students, annual mathematics growth is normally 0.15. In Figure 1 we provide a comparison of the effect size of the gain made in student mathematics performance by product for the fall semester compared to cumulative gain across the year students in the pilot.

Figure 1. Effect Size of Gains in Mathematics Performance for All Students Using the Product in 2013-14



Note: Data for Think Through Math are provided in two components: mastery of grade level content and mastery of below grade level content which is why the bar chart has both represented. Data for ALEKS include students in Middle School Course 2 (grade 7) and Course 3 (grade 8).

The cumulative effect across the 2013-14 academic year exceeded normal expected growth for students using ALEKS, Think Through Math, ST Math, Math 180 and EdReady**.** Since there was a confound in the original measure provided by Think Through Math for the preliminary findings in January, for this analysis we used a mastery performance measure, which was similar to measures of the other products and more appropriate for detecting an effect. However this measure came in two scores, one for mastery of below grade level content that students are exposed to for remediation and one for grade level content. In figure 1 we provided findings for students with mastery data at pretest and posttest for the grade level and below grade level measures. In table 1 we include an overview of the sample size of students using the products in the fall (September to January), students using the product at any point during the 2013-14 year, and students in the pilot who used the product for the entire year and have a valid pretest and posttest.

Table 1. Sample Size by Product of Students Using the Product and Students Piloting it during 2013-14

Product	September to January Users	All Student Users 2013-14	Pilot Students With Pre/Post Data 2013-14
ALEKS	1,739	3,059	1,141
Think Through Math	2,152	2,489	882
ST Math	1,596	1,469	568
Successmaker	765	765	—
Math 180	82	93	77
EdReady	206	222	178
Total	**6,540**	**8,097**	**2,846**

Note: "—"= Not available. Spring data for Successmaker have not yet been provided.

The gains made by students using these products may not be completely related to the products, but may relate to other factors. As a reminder, we conducted a cluster randomized control trial in January for three products: ALEKS, Think Through Math, and Successmaker. ALEKS was the only product where a statistically significant difference ($p<.01$) was found where students using the product outperformed students not using the product. Students in the control group were given access to the products starting in January, so we were not able to do an analysis of the same type now, since there was no control group with which to compare.

For this report we present findings from the product assessments, which are short term outcomes of this project outlined in the logic model shown in Table 2. The long term outcomes will be measured fall 2014 once the results from the state SAGE assessment are available (October 2014). At that time we will compare effect of students using these products compared to similar students in schools in the state that did not have the opportunity to have access to digital mathematics technology.

Table 2. Logic Model for the STEM Action Center Technology Pilot

Inputs	Implementation	Short Term Outcomes	Long Term Outcomes
• Grade 7 and 8 mathematics software • Grade 10 college math readiness software	• 1 day professional development • Implementation support from provider	• Progress in mastery or performance as measured by technology assessment • Increased interest in mathematics	• Increased mathematics achievement on the state assessment • High school mathematics readiness • College mathematics readiness

Product Usage

We also looked at usage data for each product to understand the diversity of use within each school and across schools for each product. We provide a comparison of usage from the fall 2013 to the full academic year (2013-14) by product in Table 3.

Table 3. Comparison of Usage Fall 2013 to Full Academic Year for Pilot Students by Product

Product	Type of Usage Data	Fall 2013 Average Usage	2013-14 Academic Year Average Usage
ALEKS	Time (Minutes)	659	1,043
Think Through Math	Number of Mathematics Problems Completed in the Program	449	704
ST Math	Time (Minutes)	708	1,385
Math 180	Time (Minutes)	575	1,259

The EdReady product was used by many schools solely as an assessment rather than curriculum for practice; therefore, usage data is not included in this report. In general we saw a slight decrease in usage across all products in the spring. We had reports from schools that computers were needed in April and May for the new state SAGE assessment which reduced access for students.

Teacher Satisfaction and Concerns

We also analyzed teacher feedback from surveys by product to understand the satisfaction and concerns they have with each product. Only about 12 percent of the participating teachers responded to the survey; therefore, these responses may not be representative of all teachers experience using the products. Responses were also include for the STEM Academy product which was used in mathematics, science, and career tech education courses, but no student performance data was available for analysis. The most common positive feedback related to student interest and progress students were making in mathematics. Concerns for ST Math were about how challenging the product became as students reached higher levels. For ALEKS the concern reported was how challenging it was to motivate some students to use the product, while the majority were very engaged. Concerns for STEM Academy were about the lack of alignment of the content to the grade level standards in the courses where it was being implemented. Teachers recommended that STEM Academy be used in a career tech education course where there would be greater alignment.

Table 4. Teacher Satisfaction and Concerns by Product for Spring 2014

Product	Number of Teachers	Responses June 2014	Percent with Satisfaction Comments	Percent with Concerned Comments
ALEKS	27	7	100%	29%
Think Through Math	27	1	100%	0%
ST Math	16	3	100%	33%
Successmaker	12	0	—	—
Math 180	3	0	—	—
EdReady	6	1	100%	0%
STEM Academy	17	3	67%	33%

Changes in Student Mathematics Engagement and Interest

Finally, we analyzed data collected on changes in student engagement and interest in mathematics that may be related to use of these technology products. This survey[3] included 19 questions related to three factors: perceived value of mathematics, ability/expectancy, and perceived task difficulty. ***Perceived Value*** is a combination of enjoyment found when doing mathematics tasks, the importance of those tasks, and the perceived extrinsic utility of mathematics. ***Perceived Ability/Expectancy*** is the students' concept of their abilities for their achievement in mathematics coursework and their assessment of their own competency and in relation to the competency of others. ***Perceived Task Difficulty*** relates to the students' perception of how difficult the subject of mathematics is and how difficult the math tasks are as well as how much effort is required to complete mathematics tasks in relation to the effort required for other subjects.

Table 5. Change in Student Mathematics Interest and Engagement Fall to Spring 2013-14

Product	Students	Perceived Value of Mathematics		Ability/Expectancy		Perceived Difficulty of Mathematics Tasks	
		Fall	***Spring***	***Fall***	***Spring***	***Fall***	***Spring***
ALEKS	365	4.83	4.50 *	4.82	4.53 *	4.45	4.26 *
Think Through Math	192	5.22	4.66 *	4.89	4.50 *	4.37	4.29
ST Math	260	4.90	4.62 *	4.71	4.44*	4.52	4.28 *
STEM Academy	30	5.35	5.08	5.14	4.94	4.04	3.90

Note: "*" is an area of change from fall to spring that was statistically significant at the p<.01 level. All changes were decreases.

For all products there was a decrease in average scores from the fall to the spring. Drs. Martin and Brasiel saw the same pattern in a study[4] they conducted of a mathematics curriculum across 5 states. We hypothesize that the results of the survey may be confounded by the extra amount of test preparation being conducted in classrooms in the spring in preparation for the state assessment. Therefore, the changes in the scores may be influenced by other factors than the students' experiences with these products. Students may also need more opportunities to see the value of mathematics and to experience success in applied mathematics to improve their belief about the value and their ability in mathematics. The work the STEM Action Center is doing to support career tech education in Utah is one way to improve student interest and engagement in mathematics providing students with the opportunity to see the value of mathematics in applied STEM settings.

Summary of Findings:

- *Students in the pilot (Oct-May 2014) using ALEKS, Think Through Math, ST Math, Math 180, and EdReady made more progress in mathematics than would be expected under normal condition in a full academic year.*
- *There was a slight decrease in usage in the spring due to the need to use computers for the state SAGE assessment.*
- *Teachers continue to report satisfaction with the digital mathematics technologies.*
- *There was a decrease in students' perceptions about mathematics. There is a need to find ways to further engage students in mathematics, such as opportunities to experience applied mathematics activities.*

This pilot was made possible by the generous donation of over 8,000 licenses by the product providers.

Next Steps

Currently the $8.5 million from HB 139 is being used to provide grants of mathematics digital technology to schools across Utah, which will meet the needs of over 150,000 secondary students in the state. In addition, there are mathematics digital technology products for students in K-6 that will also be granted this fall across the state with $5 million from HB 150. We will be assessing the effects of these products on student mathematics performance as we work with the STEM Action Center over the next year.

Notes

1. Calculation of effect size used is (gain score)/[standard deviation of the gain score/(square root of 2 times 1-r, the correlation between pretest and posttest)] from Wilson, D. B. (2001). *Practical meta-analysis* (Vol. 49). Sage.
2. Annual achievement gains under normal conditions taken from page 28 of Lipsey, M.W., Puzio, K., Yun, C., Hebert, M.A., Steinka-Fry, K., Cole, M.W., Roberts, M., Anthony, K.S., & Busick, M.D. (2012). *Translating the Statistical Representation of the Effects of Education Interventions into More Readily Interpretable Forms*. (NCSER 2013-3000). Washington, DC: National Center for Special Education Research, Institute of Education Sciences, U.S. Department of Education.
3. Eccles, J., & 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.
4. Martin, T., Brasiel, S., Turner, H., & Wise, J. (2012). *Effects of the Connected Mathematics Project 2 (CMP2) on the Mathematics Achievement of Grade 6 Students in the Mid-Atlantic Region* (NCEE 2012-4017). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

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Attachment E
Tracking and Comparing Student Performance

What follows is a description of the current and planned evaluation of performance of students participating in STEM Action Center Programs to all other similarly situated students in the State of Utah at the beginning and end of each year. Data is analyzed and

(i) Public Education High School Graduation Rates

2013-14 Secondary Mathematics Technology Pilot

For the pilot, graduation data was not part of the Memorandum of Understanding with schools. However, we will be comparing graduation rates from the pilot year to the prior year for schools with access to the technology products to similar schools without access to the technology products. There may not be enough high schools participating in the pilot to determine statistical significance of any difference, but the difference can inform future work with schools in 2014-15.

Type of Schools	Average Graduation Rate at Baseline 2012-13	Average Graduation Rate after Pilot 2013-14	Difference	Effect Size and Statistical Significance of the Difference
Schools using Product	%	%	%	ES = .## P = .##
Similar Schools not using Product	%	%	%	ES = ## P = .##

2014-16 Grant Funded Products/Programs

For 2014-16 12th grade students will have access to mathematics technology products and to high school industry certification. Similar to the pilot, we can do comparisons of graduation rates for schools using the products and programs funded through grants from the STEM Action Center for before and after their participation and compared to other schools not using the products. We have also added to the district application a request for Student State Identification (SSID) numbers in order to receive student level data for the entire state with flags for students participating in the STEM Action Center programs. In collaboration with our external evaluators at USU and USOE a propensity score matching approach will be used to match students participating in the STEM Action Center program to similar students in the state in order to understand if there was a significant effect of the program on graduation rates for these students in comparison to their matched similar students in the state. This process also includes information about the school the students attend in order to create the best possible match. Additional information about this process is provided in the Appendix.

(ii) Number of Students Taking Remedial Mathematics Courses in Higher Education

2013-14 Secondary Mathematics Technology Pilot

For the pilot, remedial coursework was not part of the Memorandum of Understanding with schools. In addition, in order to get data on this for students, one would need a student's social security number. This was not collected so this analysis will not be able to be done.

2014-16 Grant Funded Products/Programs

For the 2014-16 programs we are collecting student SSIDs which will be able to be linked to data from USHE to understand whether a student enrolled in a remedial or non-remedial mathematics course. The data for students graduating May 2015 will not be available until January 2016 if not later depending on delays. We can do a propensity score matching analysis to compare rates of enrollment in remediation for participants in STEM Action Center programs to similar non-participants. This analysis will be limited to students who enroll in the 8 colleges and Universities in Utah that participate in the Utah Data Alliance. In order to gather data for all students who attend colleges across the nation we would need to gather legal first name, last name, middle initial, and birthdate. Currently this type of data collection is not planned. Therefore the results will be limited to students attending one of the 8 colleges in the Utah Data Alliance.

(iii) Number of Students who Graduate from Utah Public Schools and begin postsecondary education program

2013-14 Secondary Mathematics Technology Pilot

For the pilot, enrollment in postsecondary education was not part of the Memorandum of Understanding with schools. In addition, in order to get data on this for students, one would need a student's social security number. This was not collected so this analysis will not be able to be done.

2014-16 Grant Funded Products/Programs

For the 2014-16 programs we are collecting student SSIDs which will be able to be linked to data from USHE to understand whether a student enrolled in a post-secondary program. The data for students graduating May 2015 will not be available until January 2016 if not later depending on delays. We can compare the rates of post-secondary enrollment for schools participating in the STEM Action Center programs compared to the prior year rates to see if there was a significant difference. We can also look at rates for similar schools. It also might be possible to match students participating to similar students based on a few prior years of data to see if there were similar or different enrollment rates. However, there may be some limitation to this analysis since there are other factors, such as family economics and other factors that may contribute to enrollment that will not be measures. This analysis would be done with propensity score matching to compare rates of enrollment in postsecondary education for participants in STEM Action Center programs to similar non-participants. This analysis will be limited to students who

enroll in the 8 colleges and Universities in Utah that participate in the Utah Data Alliance. In order to gather data for all students who attend colleges across the nation we would need to gather legal first name, last name, middle initial, and birthdate. Currently this type of data collection is not planned. Therefore the results will be limited to students attending one of the 8 colleges in the Utah Data Alliance.

(iv) Number of students, as compared to all similarly situated students, who are performing at grade level in STEM classes.

Grades in classes can be very subjective teacher to teacher, and even by school. Therefore, we recommend evaluating the STEM Action Center based on student performance on the state standardized assessment. This assessment is available for English, mathematics, and Science for grades 3 to 11.

2013-14 Secondary Mathematics Technology Pilot

For students participating in the pilot, we will be looking at significant changes in their mathematics performance. Since there was a change in the state assessment to the SAGE assessment in 2014, the baseline assessment and the end of year assessment will be different. We will work with the USOE data office to plan the best analysis given available data and an understanding of this new adaptive system. The data will be available October 2014 and we will better understand at that time the most appropriate type of analysis that can be conducted.

2014-16 Grant Funded Products/Programs

For the 2014-16 participants, we will have the new SAGE assessment data at baseline and after their participation in the STEM Action Center program that can be used to assess significant changes in their performance in comparison to a matched comparison group of students not participating (using Propensity Score Matching). The data will be available October 2016 for student participants in programs 2014-2015. For students participating in the Mathematics Technology Products and CTE products/programs in addition to these SAGE test outcomes we will also be looking at the pre/post assessments that are provided within the products as preliminary findings to measure outcomes in the middle and end of year to report progress to the board and inform decisions of whether products should continue for the 2015-16 year.

Appendix. Propensity Score Matching Analysis

It is difficult in public education to randomly assign students or teachers to programs. Since the goal of HB139 and HB150 was to meet the needs of many students in Utah, it was decided that we would not require schools and districts to randomly assign the products, but rather to select teachers and students with interest in participating and needs that can be addressed with the products. However, we also wanted to rigorously assess the effectiveness of the products/programs being implemented by the STEM Action Center. To do this, we begin by creating a comparison group of students and schools that are similar using student achievement and student demographic data that the state provides for the past few academic years.

Then we use a method called propensity score matching (PSM), which is a quasi- experimental approach for creating a comparison group. In PSM, a comparison group is formed by matching individual students using the program to be evaluated on a one-to-one basis to students who are not using that curriculum but who most-closely resemble each pilot student. Through matching students in the program to be evaluated to students not in that program on a one-to-one basis using the propensity score, a quasi-experimental control group is formed which balances the two groups to be compared in terms of important demographic and achievement variables which are related to the ultimate desired outcome—for example, student achievement in mathematics. Using the spring prior year state achievement scores, the student achievement for the two groups can be compared to see if there is a meaningful difference. There are limitation to PSM; however, when random assignment is not possible, it is the next best recommended approach to use when looking at program effectiveness.