Utah STEM Action Center Annual Report FY2021

STEM Action Center

Annual Report to the Education Interim Committee November 15, 2021

The following report is being submitted to the 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 Centers 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).**

The number of educators receiving high quality professional development

The STEM Action Center (STEM AC) supports high quality professional development through the professional learning (PL) program that aligns resources to locally identified STEM- related professional learning needs and solutions with activities such as coaching, mentoring, self-reflection, off- contract work, and effective professional learning communities (PLCs). The STEM AC also provides professional development to support educators that are participating in other programs such as the K-16 Computing Partnership program, the K-12 Math Personalized Learning program, programs with our STEM in Motion team (e.g., Leap into Science) and the annual STEM Best Practices conference.

K-12 PROFESSIONAL LEARNING

The PL program supported 46 grants in the 2020-21 school year, directly impacting 3,284 educators. The program design varies greatly within this grant program and includes solutions to locally identified issues that support their long-term strategic plan with compensation for off-contract work, lesson study in a PLC, and videos to be used for self and peer reflection.

K-16 COMPUTING PARTNERSHIPS

A total of 375 educators, as part of the K-16 Computing Partnership program, received professional development through face-to-face and zoom trainings, online courses, accredited vendor classes, and conferences.

K-12 MATH PERSONALIZED LEARNING

Educators and administrators from 551 schools received professional learning for the use of the K-12 Math Personalized Learning tools as part of the contracts with the product providers. This training ensured that educators were able to integrate the use of the software effectively as a supplement to their instruction.

STEM IN MOTION

The STEM in Motion Curriculum kit program allows teachers and educators to rent out various STEM-related curriculum kits for their classrooms for a two-week period. Teachers are able to train themselves on the material using our online videos and PDF lesson plans. 82 schools participated in the past year through our curriculum kit program and were trained in STEM lesson teaching.

ROBOTICS LIBRARY

The Robotics Library program is funded through a grant with Marathon Petroleum and consists of five robotics equipment kits placed strategically across the state through the four rural education service centers. Throughout FY21, four of the robotics kits were used to teach robotics fundamentals in rural schools and communities. Due to COVID-19 restrictions, one of the robotics kits was suspended for the 2020-2021 school year.

STEM BEST PRACTICES CONFERENCE

The annual STEM Best Practices Conference provides a variety of professional learning opportunities for educators across the state. The 2021 conference focused on experiential learning activities for educators via a brand new virtual conference platform. The conference was held on

June 21, 2021 and more than 500 educators from around the state participated during that week. The theme for the conference was *You Get What You Play For* and challenged educators to incorporate play into learning strategies while embracing failure and the iterative process. Because this conference was held virtually, we are able to keep all conference sessions and resources available to new and returning attendees for one year after the event.

It is encouraging that 90% of the respondents indicated that they plan to access conference resources and materials after the conference and 90% indicated that they would share the conference resources with friends and colleagues.

The number of students receiving services from the STEM AC and the number of students that accessed resources from the STEM AC are as follows:

- *Classroom grants:* 2,694 students were impacted by the funded classroom grant projects.
- *Competition grants:* more than 600 students were impacted through participation in STEM related competitions
- *K-12 Math Personalized Learning Program:* 164,430 students had access to supplemental math software
- *Virtual STEM Fest:* more than 21,000 students, educators, and parents participated in STEM Fest, which took place virtually on utahstemfest.com.
- *Sponsorships:* the Center supported and exhibited at 18 STEM community events and programs, thus impacting more than 11,000 students, parents, educators, administrators, community and industry partners. Due to closures as a result of COVID-19, many of the larger statewide STEM events did not take place.
- *STEM in Motion (SIM):* 8,561students were impacted through participation in the SIM programs
- *Girls Who Code Club Network:* 167 girls participated in 18 clubs
- *K-16 Computing Partnerships:* 1,984 students (participating in 41 new Computer Science class sections), 6,624 students participating in various out-of-classroom experiences, 101 students participating in work based learning activities. (Please note that students may have participated in multiple activities.)

A list of providers selected pursuant to this bill:

See Appendix A.

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

(a) STEM Action Center (STEM AC) Staff and Roles - 63M-1-3204; 1(a), (c) (i)

The STEM Action Center (STEM AC) consists of the Executive Advisory Board, a Division Director (Dr. Tami Goetz), Program Director (Sue Redington), Collaboration and Program Development Manager (Kellie Yates), Research and Implementation Manager (Clarence Ames) and

Community and Innovation Manager (Lynn Purdin), an Office Manager (Gina Muhlestein) and a Marketing and Communications Manager (David Wicai).

The STEM in Motion team (formerly the Utah STEM Bus team) consists of three team members (Becca Robison, Julienne Bailey, and Colleen Fisher). There is a part-time director for the Utah STEM Foundation (Allison Spencer), along with a Utah STEM Foundation Board.
The STEM AC works collaboratively with several other state agencies (e.g., Utah Department of Workforce Services, other divisions within the Utah Department of Cultural & Community Engagement, the Office of Energy Development, Governor's Office of Economic Opportunity etc.) to support STEM education and workforce and economic development. The STEM AC currently has one undergraduate intern that supports a variety of activities in the Center.

The STEM AC works with high school juniors and seniors, as well as undergraduates for the STEM Ambassadors program. The STEM Ambassadors help with outreach and engagement efforts such as events like STEM Fest and other community events, and help to build content on the STEM website.

The STEM Ambassador program shifted during COVID and took on a different focus. Ambassadors helped to lead virtual Code Nights for families and students. Towards the end of the fiscal year, ambassadors were able to shift back to activities in the STEM AC space. It is anticipated that a robust ambassador program with high school and college students will be back in action as FY22 progresses.

The STEM AC reports to the STEM Action Center Executive Advisory Board, with its membership and duties defined by statute. This model has worked well, with the Board providing tremendous financial and in-kind support, as well as oversight of the STEM AC's strategy, process, and accountability. The ability of the Board to have a strong role in the direction of the STEM AC, providing guidance to the Director, has led to considerable buy-in from industry and the Utah State Board of Education office. The Board has representation from industry, the Utah State Board of Education, the Utah System of Higher Education, and the Utah Department of Workforce Services.

(b) Private entity engagement - 63M-1- 3204; 1(d); 2 (e)

UTAH STEM FOUNDATION

Industry support is crucial to the mission of the STEM AC. Industry support ensures that programs and efforts connect companies into the classroom, increase STEM workforce opportunities in Utah, and enhance STEM funding and resource opportunities. The Utah STEM Foundation, with its vision and mission aligned to the STEM AC, helps to create the bridge from education to the private sector. The Foundation has helped to build relationships with industry and the resulting support has been provided in a variety of ways including cash donations, grants and sponsorships, program collaborations and in-kind support through volunteer efforts. The Utah STEM Foundation was added to the STEM AC's statute, thus allowing for the creation of a public foundation. It became official on May 10, 2017, having received the Letter of Determination from the Internal Revenue Service. The Foundation has an advisory board with industry support from Marathon Petroleum, (formerly Tesoro), Boeing, Open Text, Comcast, Micron, MHTN Architects, FireEye, Brassica Protection Products, and US Synthetic. A part-time director (Allison Spencer) oversees the functions and activities of the Foundation Board, as well as the receipt of all donations from corporate partners. The Foundation Board continues to develop and expand on many new and existing community partners and donors, who are in turn increasing their donations each year.

Programs that are supported by the Foundation include:

The Utah STEM Foundation helps to support STEMFest, STEM in Motion, the STEM On Stage Assembly with Paul Brewer, STEM Best Practices, Innovation Incubators (classroom/competition), Green Our Planet Hydroponics program, To Learn early math kits, STEMSpots, funding for the new STEM Innovation Hub, as well as many other STEM initiatives that have impact statewide. The Utah STEM Foundation has also assisted the Department of Cultural & Community Engagement (CCE) to serve as a fiscal agent to the Divisions of Multicultural Affairs and Indian Affairs with STEM and leadership donations, and to the Utah Megablock Raptor project through the Division of Natural Resources.

Cash Donations for fiscal year 2021:
The Utah STEM Foundation received over $300,000 in monetary donations, and close to $2,500 in in-kind contributions in fiscal year 2021.

Utah STEM Foundation Grant Funding

The Utah STEM Foundation has been critical in leveraging grant opportunities for the STEM AC, in particular, those that are affiliated with industry partners.

The following new grants were secured during the fiscal year 2021: $75,000 was awarded from Boeing for the Utah STEM Action Center's To Learn early math kit series.

The To Learn early math kit series is an innovative program, initially created and implemented by Project Child Success in the State of Washington as an in person opportunity. The STEM in Motion (SIM) team quickly adapted the in person format to a kit that can be taken home or used in the classroom or community events. The kit series was piloted for the last several years, with support from organizations including Comcast and Boeing. The To Learn kit series integrates math into everyday fun activities. These are activities that children, ages 2-8, can easily embrace at home with their family, while supporting their development of early math skills.

The Utah STEM Action Center has already collaborated with several organizations and industry partners to assemble the To Learn kits and has collaborated on dissemination to communities in the greatest need for math improvement and/or lack of resources. The preliminary qualitative data indicates that the programs are effective, engaging and are serving an important role in early math learning.

Utah STEM Foundation Highlights

- The Utahraptor Megablock Fossil project highlights the study and excavation of dinosaurs native to Utah (Utahraptor is Utah's official state dinosaur). The Megablock contains several exceptionally well-preserved Utahraptor skeletons that students, adults, and community members have been able to observe previously at Utah's Museum of Ancient Life at Thanksgiving Point. In February, 2020 the Megablock was moved to a new preparation laboratory at the Utah Department of Natural Resources campus in Salt Lake City. Moving the block has, and will continue, to allow UGS paleontologists, contractors, volunteers, and university students to work more closely and frequently on the block to extract and prepare bones and other fossils. The Utah STEM Foundation agreed to assist the Utah Geological Survey in accepting donations to further this project's success and have overseen over $67,000 in donations during FY21.

Utah STEM Foundation Donor Highlights

- ARUP selected the Utah STEM Foundation as one of the benefactors of their Employee giving program for 2 years. ARUP has also been a very supportive sponsor of STEMFest, and hosted nearly 120 students as part of the American Indian Services summer PREP program at their facility in July 2021 to discuss future career opportunities.
- Boeing supports STEM efforts that demonstrate collective impact and has donated $75,000 in FY21 to work on To Learn early math kits that will reach students statewide.
- Comcast has been a champion by assisting to fund programs, STEM events, as well as create and distribute communication materials to promote awareness for STEM.
- Fidelity Investments has supported our STEMFest events in person and also offers free financial literacy workshops for students in the classroom.
- Hill Air Force Base has worked closely with the STEM AC and Utah STEM Foundation to allocate funding to educators, schools, and other organizations, providing STEM opportunities statewide.
- Intermountain Healthcare has championed STEM curriculum efforts, bringing career awareness to students and educators statewide. They are supporting the creation of middle school and junior high outreach and engagement resources, such as an interactive board game, to promote healthcare careers.
- The Larry H. & Gail Miller Family Foundation has played an integral role in bringing STEM to schools statewide with the STEM in Motion Program.
- Micron supports the STEM in Motion program and has also worked closely with the STEM AC and Utah STEM Foundation to allocate funding to educators, schools, and other organizations that are providing STEM opportunities.
- US Synthetic has championed bringing partnerships to the STEM community, and has been our largest sponsor of STEMFest every year since our inaugural event.
- Jeffery R. and Katie C Nelson Family Foundation has provided ongoing support to the Utah STEM AC and pledged 10,000 to help create the Utah STEM Artist in Residence Program that will be held in our new Innovation Hub.
- Northrop Grumman provided $10,000 to start our STEM Spots initiative to bring STEM books, kits, and other materials to underserved areas.
- Industry Support at Virtual STEM Best Practices Conference: Even though our annual conference for teachers was virtual, the support and in-kind donations provided from various companies was still incredible. To add a level of appreciation for all of the work educators have done during the pandemic, company support was expressed via short videos

during the conference. Governor Cox, Ruby Snap, The Jazz, Southern Utah University, and others relayed a short message of gratitude and support.

COMMUNITY IMPACT -- SPONSORED EVENTS

The STEM AC uses a portion of
its operational budget, leveraged with industry support, to sponsor various events. Sponsored events help to provide exposure to STEM education and career opportunities for students and communities.

The following list includes examples of programs and events that received STEM Action Center sponsorship funding in FY21, as well as those hosted by the STEM Action Center (a full list can be found with Appendix B).

USU Extension AgriScience Triathlon

The Utah 4-H AgriScience Triathlon is an Agricultural Science based activity centered around the STEM aspect of Agriculture. Youth Programs STEM and AgriScience leadership has combined efforts over this last year to help youth traditionally involved in Agricultural projects (livestock, small animal, gardening, horse 4-H projects) to better understand the application of technology to the agricultural fields.

Utah STEMFest

The STEM Action Center, together with Utah's STEM industries, showcased exciting STEM career paths and hands-on STEM activities in our sixth annual STEM Fest. In 2020, STEM Fest went virtual due to COVID-19 restrictions during the week of November 8, 2020. Utahstemfest.com was completely rebuilt to provide students, educators, and parents an immersive experience that allowed them to engage with STEAM articles, resources, and hands-on activities. As a result of going virtual, we were able to keep those resources and activities available to attendees throughout the year after the Week of STEM was completed. This allowed us to reach more people over a longer period of time. Website data from November 8, 2020 through the end of FY21 shows that the 2020 Virtual STEM Fest had more than 21,000 new visitors viewing more than 150,000 pages on the website.

Another component of the 2020 STEM Fest was a STEM magazine that we created in partnership with Utah Business. The STEM Magazine was distributed across the state to schools, school districts, and regional education centers. The magazines featured articles and stories from STEM professionals, STEM AC staff, and others to help inspire students and inform them about potential opportunities that could be available to them in the future.

In 2021, the STEM AC will continue to host STEM Fest virtually on utahstemfest.com and will also print the second edition of the magazine. COVID-19 may have been a barrier to hosting STEM Fest in person like we used to, but it also afforded us new opportunities to get creative and think about how we might be able to do things differently while maintaining its impact.

STEM Best Practices Conference

The annual STEM Best Practices provides a variety of professional learning opportunities for educators. The 2021 Best Practices conference focused on experiential learning activities for educators via a brand new virtual conference platform. The conference was held on June 21, 2021, and more than 500 educators from around the state participated during that week. The theme for the conference was You Get What You Play For and challenged educators to incorporate play into learning strategies while embracing failure and the iterative process.

Because the conference was held virtually, we were able to keep all conference sessions and resources available to new and returning attendees for one year after the event. After the event, a survey was sent to attendees. This survey received 213 responses. Participants found the event helpful (95%), found the platform easy to use (91%), and 90% were planning and accessing the conference materials after the event was over. 90% were also planning on sharing conference material with their colleagues.

STEM IN MOTION (SIM)

The STEM in Motion (SIM) Program brings exciting STEM activities and resources to schools and communities all across Utah. The outcomes from a SIM experience include increased student engagement and enthusiasm for STEM activities, increased teacher awareness of STEM education, and increased industry investment in STEM.

The SIM team currently uses STEM curriculum that provides experiential, real-world, project-based learning opportunities for students. The program also ties classroom-learning experiences to STEM AC classroom grants to help educators get the resources they need to continue the lessons after the SIM experience. The connection to STEM careers is what makes the SIM program unique from many other informal STEM programs in Utah.

The team works closely with the Utah State Board of Education (USBE) to make sure all curricula are aligned to Utah Core Standards and have career pathways tied to local Utah companies. The STEM AC received a grant for $1.5 million in 2016 from Marathon Petroleum (formerly Tesoro) to fund the design, purchase, retrofitting, and operation of a mobile classroom. The Utah Transit Authority (UTA) donated two, 40-foot buses and a ten-person van to the STEM AC. The first bus was retrofitted and had its debut on August 16, 2017, at the Utah State Capitol, with Governor Herbert having the honor of cutting the ribbon. The van, nicknamed the Micro USB, has been retrofitted and wrapped to help engage students, educators, families and industry partners at events around the state. The SIM team has been actively engaged in partnering with local companies to enhance the curricula selection every year. Programs will rotate in and out every two years depending on teacher interest to keep programs exciting for educators and students.

Currently, the SIM team has redesigned the classroom program into a curriculum kit checkout program due to COVID. Teachers can choose from 11 different curricula to checkout for a two-week period, which includes all the materials necessary, and a Google drive with video lesson plans, PDF lesson plans and follow up activities. The new STEM curriculum materials are thoroughly tested before each school year. Several schools have offered to help review the curriculum materials to ensure that the materials align with standards, are age and grade-appropriate, and are a good learning experience. The educators receive two professional development hours that can be used for re-licensure points in exchange for their participation and feedback.

The SIM team added two curriculum kits for the 2021-2022 school year: Utah's Water Ecosystems and 3D Printing & Design, in response to teacher feedback about curriculum needs. The current curriculum includes:

- Physics and Forces (K-3)
- Bee-bots (K-3)
- Hands-on Coding (1-3)
- Power Tiles (1-3)
- Sphero Robotics (2-8)
- Senses and the Brain (3-6)
- 3D Printing & Design (6-8)
- Mars Mission: (4-8)
- Game Design & Statistics: (4-8)
- Renewable Energy: (4-8)
- Utah's Water Ecosystems (3-7)

	2017-2018	**2018-2019**	**2019-2020 *impacted due to the coronavirus**	**2020-2021**
Schools Visited	53	64	47	70 (only kit drop offs, no in-person teaching)
Students Reached	8,437	10,780	6,171	Over 8,000
School Districts Visited	19	20	17	26
Total Programs Presented	337	449	288	NA

During the 2020-2021 school year, the SIM team continued to support classrooms through a kit-style program. The team worked with teachers in various schools to determine the best model for the new kit program, and it resulted in a highly successful shift. Teachers were so impressed with the kit program that the team will continue it even after COVID, and combine it with the in-classroom teaching. The curriculum is also made available to educators in the form of PDF documents, so that educators can access any resources used, recreate any activities, or explore any concepts as part of their continuing STEM instruction.

Over 50% of the schools the SIM Team goes to are Title 1 schools, and over ⅓ of all students are qualified for free or reduced lunch. Surveys administered to students before and after participation in a SIM experience reported that students had an increased interest in STEM and an increased interest in having a career in STEM after the SIM experience. Based on teacher feedback surveys after a STEM in Motion visit, over 90% of educators said the SIM program introduced their students to new material and provided a learning experience not usually available in their school. Further, 99% of educators surveyed would recommend the STEM in Motion experience to other educators. This program provides opportunities and access to STEM education that educators and students may not get in any other capacity.

Additional teacher testimonials about the STEM in Motion Program:

“Our entire school of 85 students had access to this kit both with their teachers and in the after school program during the two weeks they were in our building. Thanks so much!”

“This was a fantastic opportunity for our school. It created excitement for STEM not only for the students, but also the teachers! ”

“Thanks for making this all work with the times! The kids had a blast! ”

“It is such a great idea to have kits move from school to school, so everyone can learn. Thank you!”

In addition to classroom visits, the SIM team works on a variety of other outreach programs, including the Robotics Library. The Robotics Library project started with a $30,000 donation from Marathon Petroleum and the belief that robotics resources should be accessible to every educator in Utah. Five robotics kits were created with the support of the donation and the kits are housed strategically around the state.

Each kit includes a variety of robotics equipment designed to be developmentally appropriate for grades K-12: 5 Bee-Bot robotics, intended for grades K-1; 10 Ozobot Bit robots, intended for grades 2-3; and 10 LEGO Mindstorms EV3 robots, intended for grades 4-12. These kits are housed at the four rural education service centers: the Southeast Education Service Center in Price, Utah; the Southwest Educational Development Center in Cedar City, Utah; Central Utah Educational Services in Richfield, Utah; and Northeastern Utah Educational Services in Heber City, Utah. One kit is housed at the STEM Action Center offices to be loaned to schools along the Wasatch Front. Educators can check out this equipment free of charge from any of these locations, and are provided free training and professional development to ensure educators feel comfortable with using the technology in their classrooms. Currently the impact of this program is being assessed to determine the feasibility of scaling the program to additional kits. Due to COVID-19 restrictions, only four of the five kits were used during the 2020-2021 school year.

The STEM for Life grant from Intermountain Healthcare is focusing on kits and activities that promote healthcare careers that are in high demand. The targeted projects link skills, aptitudes and passions to careers in fun, and engaging ways. For example, the SIM team has created a board game called Healthcare Heroes to teach students 5th-7th grade about healthcare careers and work together to end an imaginary pandemic in Utah. The students will role-play as a different Intermountain Healthcare professional and work together to help stop an outbreak before it overtakes the state. This game will provide meaningful exposure to lesser-known careers through Intermountain Healthcare, and let students explore firsthand what these professionals do. The game is currently being tested in classrooms, and will be available through the SIM kit program this fall.

In response to the positive student response to the initial To Learn kit series (piloted early in 2020), the SIM team developed an additional 4500 kits across five total subjects. The To Learn kits focus on early math learning, and will be distributed to students via schools, out-of-school time programs, and other community-based programs. These kits targeted students from 2-8, with half of the kits being focused on 2-4 year olds and the other half being focused on 5-8 year olds. The activities combined math skills with art, movement, engineering, outdoor exploration, and game play.

(c) R&D role of STEM AC - 63M-1- 3204; 2 (a)- (c); (f)

THE VALUE OF THIRD PARTY EVALUATION

Anytime an organization undertakes to evaluate its own programs, there is potential for bias. The STEM AC continues to integrate rigorous third-party evaluation to increase accountability and research integrity for the following programs: K-12 Math Personalized Learning, Professional Learning, and K-16 Computing Partnerships. The STEM AC has a contract for third party evaluation with the Utah Education Policy Center (UEPC) at the University of Utah, which supports credible third party evaluation that sustains a high level of fidelity and objectivity. The parameters of the evaluation (such as metrics and data that is to be collected) are defined by the requirements of the STEM AC's statute, and recommendations by the third-party evaluator, the Utah State Board of Education (USBE), and LEA partners.

Comprehensive logic models are created for all programs, and the outputs and outcomes defined in the logic models drive the evaluation process. The STEM AC team reviews the third party evaluation scope annually to ensure that the data fulfills the metrics identified in the logic models for each program. The STEM AC team also looks for opportunities to shift a portion of the evaluation work to the Center staff that will not compromise the integrity of the evaluation (i.e., fully developed surveys that merely need to be administered).

Product and education partners, industry leaders, and research centers from this state and other states have contacted STEM Action Center staff to ask questions about how to conduct rigorous research on their programs. Due in part to this reputation, the Center has received additional opportunities, such as the STEM Landscape Analysis grant (see below) from Boeing, to make positive impacts on K-12 education through industry partnerships.

THE INTEGRATION OF R&D INTO STEM AC PROGRAMS

An additional R&D function was added to the K-12 Math Personalized Learning program beginning with the 2017-18 school year. The STEM AC worked with the State Procurement Office to create a process to allow new math personalized learning programs, which met all of the requirements of the original RFP, to be piloted at limited capacity (minimum of 1,000 students and maximum of 3,000) for two years, at no cost to the participating LEAs and be willing to be integrated into the evaluation process. Outcomes from the new products are compared to products currently under contract. If the performance of students using a new product meets or exceeds the average performance of students using other personalized learning products, that product will be added to an approved vendor list. Starting in the 2020-2021 school year, new providers who already have strong usage in Utah can submit data from past years for analysis. This effectively shaves a full year off of the pilot period for any providers who wish to participate, increasing both the effectiveness and the efficiency of this program. In FY20, four new products were cleared to begin the pilot process starting in the 2020-2021 school year. Unfortunately, schools had more uncertainty than usual this year (FY21), and only one of the four providers was able to meet all the requirements of the pilot program. We will have data on the efficacy of that product in January of 2022.

The STEM AC received a grant from Boeing to initiate a landscape study to capture the current state of STEM education and employment in Utah. Working with the Utah Data Research Center (UDRC) and the Utah Education Policy Center (UEPC), the STEM AC will examine trends and patterns in enrollment, graduation, and employment in STEM over multiple years. The goal is to identify factors that increase students' likelihood to persist in STEM fields over time. Another goal of the study is to determine if companies are finding talent easier, or finding employees that are better prepared to succeed in their companies, thus resulting in higher retention. The data will be used to inform monitor and determine strategic responses to programs, as well as marketing and communications efforts. The interactive report can be found at the following link:

https://uepc.utah.edu/our-work/stem-landscape-interactive-report/

The STEM Action Center actively seeks out grant opportunities that support research that can help to inform and support innovative program development and assessment. Examples include the current National Science Foundation (NSF) grant, Linking Attitudes and Behaviors for Student Success, which collects data that helps to inform more effective communication strategies to recruit students into Career and Technical Education pathways. Another example is the NSF planning grant in partnership with Utah State University for the development of the Utah STEM Master Educator Incubation Center (USMEIC).

(d) Review and acquire STEM education- related technology - 63M-1-3204 2 (c)

There are several programs at the STEM AC that review new education-based technologies that can help to supplement instruction in classrooms, as well as informal and community-based efforts. The criteria for review focus on quality of the resource, user friendliness for implementation in a variety of environments, implementation support included with the resource and cost effectiveness that will impact scalability and sustainability. Examples of these are a new technology using robotics to teach early math. The STEM AC Innovation Hub, which opened in June of 2021, will play a large role in testing new technologies and resources that can support STEM education and training.

The K-16 Computing Partnership program has provided continued opportunities to review resources that support coding and other areas of integrated computing. There were several programs and products included in awarded grants during the 2020-21 school year that include SkillStruck, 4-H Extension, Code Ninjas,, Code Changers, and Future in Design.

One goal of the STEM in Motion (SIM) program is to identify and utilize new and innovative approaches in technology. They are currently looking at various robotics platforms for the new Innovation Hub and hydroponics resources for classrooms and community-based facilities such as state libraries.

Augmented Reality/Virtual Reality (AR/VR) is emerging as a resource that has the potential to transform classrooms and benefit a wide variety of learners. Throughout FY20, the SIM team reviewed and vetted a number of AR/VR platforms as they relate to STEM and interdisciplinary educators. The Center is now working with Transfr to deploy the technology as a more effective approach to career exposure and counseling.

The STEM AC works diligently to secure federal (such as the NSF grants previously described) and corporate grants (such as the Boeing grant previously described) that support projects and ideas, which are aligned with the Center's strategic plan, but increases the STEM AC's ability to bring new and innovative tools to Utah classrooms at no cost. These grants are ideal to pilot new STEM resources in a low risk approach, providing proof of concept and effectiveness of the resource. An example of a grant partnership is the partnership with the Utah Advanced Manufacturing and Materials Initiative (UAMMI). The STEM AC is partnering with UAMMI to develop an advanced manufacturing kit for middle/junior high school girls that not only exposes them to careers in advanced manufacturing, but helps to them to build technical capacity for 3D printing.

(e) Use resources to bring the latest STEM education learning tools into the classroom - 63M-1-3204 2 (f)

The STEM AC works closely with education partners and the STEM community to identify gaps and needs in STEM education, both for classrooms and for informal STEM opportunities. The intent is to connect new STEM education learning tools and resources as potential solutions to the identified gaps and needs in order to support and improve STEM instruction. This is described in the previous section as it relates to several of the STEM AC programs. The STEM AC recently completed a nine month strategic planning process. Several gaps emerged including a need for early STEM learning resources. The STEM AC is now piloting several new math programs that provide resources to parents to support their "at home" instruction for their children. The To Learn kits, described previously in the STEM in Motion section of this report, are one of the pilot programs launched during FY21.

The annual STEM Best Practices conference has been in place since 2015 and has the main goal of bringing together Utah STEM (and non-STEM) educators to showcase the latest learning tools and practices in the classroom. This provides an opportunity to share ideas and promote the use of the latest in STEM resources.

The R&D mechanism that is integrated into the K-12 Math Personalized Learning program (discussed previously) is a good example of how the STEM AC works to identify and assess the best resources for math instruction.

There are several STEM AC programs that “fuel the innovation engine” of the Center.

(1) The STEM AC provides small Innovation grants, through the Innovation Incubators micro-grant program. These funds are awarded to classroom educators to support the design and implementation of new STEM activities. This grant program is discussed in detail in the following sections.

(2) The K-16 Computing Partnership Initiative provides opportunities to support promising practices in K-12 computing education. For example, Murray City School District (MCSD) has established a unique “in-house” computing internship program in response to the difficulty of placing students with industry sites. PowerPlay interns receive an $11 per hour stipend, which allows students of all backgrounds to participate and benefit. The MCSD interns are responsible for preparing, repairing, and updating student Chromebooks. They are in-classroom experts for teachers' technology assistance and teach coding in the after-school coding programs. They also deploy Private LTE radios and assemble LTE routers for students. In 2020-21, the interns deployed wiring and antennas for the first SBRS in-building 5G network in the world. Despite challenges with COVID, MCSD provided seven internships in the Fall of 2020 and five internships in the Spring of 2021.

As San Juan School District (SJSD) covers 7,933 square miles, this Computing Partnerships grantee determined the best use of its makerspace efforts would be the equipping of a mobile option. SJSD purchased a 7’x14’ trailer and consulted with the STEM Action Center to build storage shelves and select durable 3D printers, laser engravers, CNC, robotics classroom sets, etc., able to endure the miles of travel. Schools request the trailer for projects aligned with classroom learning and for special events. Through this mobile effort, SJSD intends to provide equitable access to materials and equipment to schools that would otherwise not be able to afford the contents and have no space to store the materials and equipment.

(3) The Utah STEM in Motion (SIM) team members are constantly developing and testing new resources. For example, the SIM team has started creating professional development webinars for educators to learn how to use certain STEM technologies, and dive deeper into the curriculum materials presented to them during STEM in Motion visits. The Robotics Library will also bring new and innovative tools into Utah classrooms at no cost. Educators can check out a variety of different robotics classroom sets from their nearest resource library and have step by step tutorials on how to use the robots, and in-depth curriculum to guide their classes in their exploration. The robotics libraries have found tremendous success in rural communities, such as the program at the Southeast Education Service Center (SESC) that has not only expanded capacity but committed ongoing internal funds to continue to support the program.

The end of the 2019-20 school year provided an unexpected opportunity for the SIM team to pivot and implement new ways to adapt their “in person” curriculum materials and activities to a blended model. This shift helped to improve the STEM AC resources offered to students and educators. This adaptation was in response to the coronavirus, but has proven to be highly successful and effective so far.

The reputation of the STEM AC, both locally and nationally, has resulted in the STEM AC being invited to join existing partnerships, or apply for grant funding to launch new programs. These programs bring new resources to educators, parents and the community. The collaborative projects have leveraged partnerships with numerous organizations including Green our Planet, the Utah Division of State Libraries, Intermountain Healthcare, America Makes, Promise South Salt Lake, Jacobsen Innovations, Utah Advanced Manufacturing and Materials Initiative,YMCA of Northern Utah, Jordan Prep Summer Program, FIRST Robotics, and Girl Scouts of Utah, to name a few.

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

The STEM AC funds and oversees the Innovation Incubator program. This program includes three micro-grant opportunities: (1) Student Competition (2) Classroom and (3) Organization grants.

COMPETITION GRANTS

Studies show that students who participate in STEM competitions are much more likely to pursue STEM careers (Miller, et al, 2018). The STEM Competitions Grant is intended to support K-12 students' participation in STEM competitions. Applications for the grant program must be completed by a school-level representative on behalf of the students benefiting from the grant in order to be accepted. The school-level representative oversees the funding and is responsible for reporting outcomes. Competition grants cover costs for supplies, registration, and other expenses related to participation in STEM fairs, camps, and competitions. Schools may request up to $100 per participating student, and receive funding based on the strength of their application. A review team made up of other grant applicants, focusing on sustainable student impact, helped to generate scores. Before the end of the school year, each awarded school must submit detailed receipts and project completion reports showcasing what students accomplished. During a typical year, representatives from the STEM AC visit as many sites as possible to help judge events, talk to educators and students, and get a feel for what schools are doing around the state. This year, travel was restricted, so we reached out to educators directly and asked them to report on how things went, what they were able to accomplish, and how projects impacted students.

Educators reported that in spite of global challenges, students were able to master content that could translate directly into STEM careers (such as design, programming, and debugging), and developed 21st century skills (e.g. collaboration, creativity, persistence) in ways traditional classroom learning doesn't always facilitate.

"This project helps students see that STEM is more than just learning about the subjects in a classroom, but actually putting what they learned into a real product. They used the science of physics to figure out the gear ratio needed to launch a ball to the desired length and what angle is needed with the ball speed to hit the target. They used technology to program the robot, to wire the robot, and how the motor controller controlled the flow. They used engineering to build the whole thing and how they should layout the wires. They used math to figure out how long to cut things, how to find the angles, etc. I feel like this is the best product for students to see what real world STEM jobs can look like."

- Chelsey Beck

Grantees stressed that access to these opportunities helped them reach traditionally marginalized students that would have been unable to participate in programming without these funds. In many cases, grantees indicated that without STEM AC support, they would not be able to run these programs at all. Many grantees also highlighted the fact that this grant allowed them to focus fully on helping the students because it eased the burden of scrounging for resources that usually occupies much of their time that would otherwise be spent mentoring and coaching.

"At the onset of our work with Palmer Court, we would routinely describe how this project would help these kids. The workers were telling us not to dream too big or set too big a goal, since these kids would likely not complete high school. In about 9 months, the kids were excited about programming and designing robots, and are looking forward to next year. This has completely altered their mindset as to what is possible in their futures."

- Clief Castleton

"Many of the students that participated in the Science Fair are underserved in some way and for them to work through a project and for some of them to place in the state science fair was a pretty big deal. As students worked through their projects they not only learned about the science content that they were working on, but they also became better presenters, experts in their field and gained self-confidence in the process. The FTC Team is an incredible group of students that work well together, but who had to really organize themselves in order to get all of the work done. They impressively and cohesively built a beautiful, working robot as well as an awesome outreach program."

- Heather Lambert

The grant program is popular and for the 2020-21 school year grants were awarded to 22 schools. In their project completion reports, grantees also reported that participation in these opportunities positively impacted students' confidence in STEM subjects, helped develop important interpersonal skills, and even resulted in students choosing to go to college and choose

STEM majors. Though many programs had to shift due to unusual circumstances this year, which resulted in a few disappointments, nearly all grantees were able to provide engaging activities resulting in increased STEM interest and engagement among their students. Additional report details, including a list of participating schools and number of students impacted can be found at https://docs.google.com/spreadsheets/d/10Ekiv83J3Ihq5CqvGsXLtacor6rSm9cJS5iPMIlc210/edit?usp=sharing.

"We had a very successful year, considering that we had to accommodate and adapt for COVID concerns. We were able to nearly double participation, compared to last year. We were also able to increase the number of competitions that we are involved in. One of our teams won the design award in back to back competitions. We were also able to integrate VEX design and programming into the classroom during this school year, with the addition of an assistant coach from the CTE department."
- James Smith

CLASSROOM GRANTS

Classroom grants directly support educators to pilot inventive approaches to STEM education, recognizing that innovative curricular resources developed by local educators need to be replicated and spread as widely as possible throughout the state. Remote schooling and not allowing the sharing of classroom sets of materials limited the types of proposals typically associated with this grant, along with the cancellation of field trips from almost all LEAs for most, if not all, of the 20-21 school year.

For FY21, a total of 52 completed grant applications were received. Of those applications, 37 proposals (71%) received a portion of the funds requested. Typically, applications are scored by previous classroom grant awardees. Due to the additional demands placed on educators at the beginning of the school year, STEM AC staff reviewed all proposals, using a rubric to determine which proposals would be funded. The amount of funding for classroom grants in FY21 totals just over $40,000.00, with an impact on 4130 Utah students. In FY21, 14 of 37 (38%) of classroom grants were awarded to educators that identified their students as rural. A summary of the LEAs, grades, and number of students can be found here: https://docs.google.com/spreadsheets/d/1-yvV4LntBKT8OxVG7xzxtRROgj5mNq0Yo3LvXGO4yz0/edit?usp=sharing.

Lesson plans are requested from awardees in order to facilitate increased access to and involvement with innovative STEM curricula throughout Utah. These resources have been made available to Utah educators via the STEM Action Center's website. Grant awardees were also asked to present their project in a session as part of the STEM Best Practices conference, which was held virtually in June of 2021. Participants receiving support are expected to complete a final report that describes outputs and outcomes. These reports are critical to educators that choose to utilize the shared materials as it provides follow up information and suggestions to other educators. Responses for the final report vary greatly, but several awardees commented this year on allowing students to have access to hands-on resources:

"This project resulted in increased learning and mastery of essential kindergarten math skills. My students have done amazingly well on all of their benchmark tests in math this year. (Most of them scoring 100%.) The math materials exposed any superficial understanding, which helped me know where to intervene. They also helped students build a strong and deep understanding of the math. This project granted them daily access to fun and engaging materials that gave them the individualized practice needed to achieve mastery of these targeted skills."

"This unit was honestly a dream come true after this school year. I am exhausted from trying to teach online and in person and I feel like I started to use too many worksheets for my sanity. It was great to have resources and motivation to get back to research and hands on learning. The kids had so many questions!! It took twice as long for every activity because they were so engaged and just asking so many questions. This is a big unit. It included lots of hands on learning and is a really big storyline. I used Nearpod for some of the instructional pieces. It took quite a bit of time to create the Powerpoints and assessments needed for this unit. The kids had so many questions so be prepared to not know all the answers and find the answer together. For much of this year, as painful as it is to admit it, I was not the teacher I want to be. I went into survival mode and I was miserable, hating this year, and truthfully so were the students. Having this grant money, forced me to step up my game. Yes, it was a TON of work. Yes, it was SO MUCH prep work. The kids loved it! It makes such a difference at the end of the day to have engaged students. I feel back in love with teaching. I remembered why I love my job. I remembered what my job really and passion really are! This COVID nightmare will end. I loved the engagement, problem solving, excitement, and questioning that use to be part of my classroom brought back to life."

"Working through the core and curriculum to teach the students about fossil fuels, resources and renewable vs nonrenewable I was able to staircase their learning and build the concepts one after the other. We talked through how these resources are made, how we use them and what happens when we overuse them, finishing the discussion on what to do about alternatives. This grant money is so important to us in the more rural districts. Each year this money has let us give our students SO MANY opportunities that our teaching has just gotten better each year. Thanks again!!"

"This has helped me as an instructor to let go, and let the students problem solve. I was as new to the Sphero's were as most of the kids, so they were pretty well on their own to figure it all out, and guess what, they did! Most of them a lot quicker than I figured it out.
It also helped me realized that applying for a getting a grant is totally possible. I was always a little scared to apply for a grant, but it wasn't that bad at all, and the outcome was awesome! I will definitely be applying again."

"Our projects also helped me to learn what students were capable of and how much they enjoyed engineering. Seeing their visible interest in STEM projects made me consider more capacity for hands-on learning in the classroom in years to come."

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

The STEM AC Director, Dr. Goetz, participated in the annual Midwest STEM Directors Symposium in August, and attends other STEM events such as the annual Washington STEM conference and the Association of Career and Technical Education (ACTE). The STEM AC has worked with the Education Commission of the States on several "thought leader" efforts for their reports such as Early STEM Learning and Equity and Access in STEM. The STEM AC is serving as a co-PI, and lead state for the western region, in a national Alliance planning grant with the National Science Foundation's INCLUDES program. The focus of this grant is to broaden participation in STEM, and specifically in Career and Technical Education in the middle grades. South Carolina and Ohio are serving as the other regional co-PIs.

The STEM AC team has adapted several best practices from other states including the new *To Learn* early math kits that were developed during spring of 2020 and will be deployed and evaluated over the 2020-21 school year. The Center is in the process of adapting the Early Learning and Language Opportunities (ELLO) to early math support for parents and communities.

(h) Provide a Utah best practices data- base - 63M-1-3204, 2 (j)

The STEM Action Center website provides access to best practices and content that targets students, parents, educators, and industry partners. The website was redesigned in 2021 to better serve the STEM education community, offering a dynamic and informative user experience for all stakeholder groups. The new website launched in April 2021, complete with a repository of STEM content, showcasing innovative STEM ideas for use in the classroom and at home. their own, rate the resources provided by peers, provide feedback, and connect with other Utah educators. Furthermore, the new STEM AC website now exists in the same platform as other CCE division websites and is now supported by the Department of Technology Services with the State of Utah. This new platform allows the STEM AC staff to better manage the website and gives us the ability to customize the content.

(i) Keep track of how the best practices database is being used and how many are using it - 63M-1-3204 2 (k) i and ii

The new STEM AC website is still equipped with analytics tools from Google Analytics to provide insight as to how people are engaging with the content. Since the re-launch in April 2021, there have been more than 7,000 new users to the website. The STEM AC website continues to be a reliable resource for educators, students, parents and industry professionals looking to engage with STEM education in Utah.

(j) Join and participate in a national STEM network - 63M-1-3204 2(l)

The STEM AC has determined that resources can be accessed readily without paying for membership in the national organizations such as STEMx or STEMConnector. There are greater benefits to attending key conferences or symposia to engage with the larger network of state STEM leaders. Further, several of the national organizations have become more member-focused and less about providing services, which diminishes the role that they can play for an organization such as the STEM AC.

(k) STEM School Designation - 63M-1- 3204, 2 (n)

The STEM AC, working with the Utah State Board of Education (USBE), generated a comprehensive plan for a STEM School Designation program, which was included in the FY15 annual report. The USBE and the STEM AC Executive Board approved the criteria in FY15. Over the course of applying for designation, schools complete a self-evaluation on 10 overarching dimensions, which break down into 37 elements. Each element is evaluated by the applicant school and scores are supported with narrative and artifact evidence submitted to the review committee. The review committee is composed of STEM AC staff, as well as administrators planning to apply the following school year, in addition to each applying school providing a reviewer as well. It is important to note that the application to become a designated STEM School is not easy. It takes time and considerable thought and strategy. In spite of the level of work required to complete an application, there has been considerable excitement. The first solicitation for applications was released in early September of 2015, with 19 schools awarded a designation at one of the four designation levels in FY16. An additional 12 Dual Language Immersion schools were also granted STEM School Designations.

In FY17, seven additional schools were awarded new designations, with an additional school applying for a higher level of designation. Nine schools were awarded designations in June 2018, three of which were existing awardees that had applied for an increase in designation level, resulting in 43 STEM school designations across the state of Utah. In FY19, eight new schools and one school seeking an increased designation level applied and were awarded a designation. In FY20, there were also seven new STEM School Designations, one school receiving an increased level of designation, and two schools that received re-designation throughout the state in FY2020. FY21 coincided with the first set of expiring STEM Designations. While schools were offered support in their re-designation, if desired, many of the first round of designees were not interested in or able to re-designate while coping with the impacts of covid19 on their teachers and staff. An additional impact was the dissolving of a separate DLI designation, requiring those schools to reapply as their five years expired. Even so, six schools were re-designated as STEM schools, with another school increasing their designation level from Gold to Platinum. There are currently 37 STEM Designated schools across the state. Designations are recognized for five years, requiring a school to reapply at the end of that time to maintain the designation. For schools that use reviewer feedback to create and implement improvements within those five years, a modified application process is used to increase the designation level. A summary of the awardees can be found here: https://docs.google.com/spreadsheets/d/1_kM5U4VpuvVW9AF3QcriMsO9XzGSGjoE6i5iUaWEaRE/edit?usp=sharing

Moving forward, program leaders have started a multi-state consortium that meets quarterly to discuss challenges, barriers, and lessons learned with STEM designation programs across the nation. New research is also shared, with an effort to maintain the level of accomplishment associated with this type of designation. It is the intent of the STEM AC to focus on recruiting and supporting Title I schools, with the assistance and support of industry partners, to receive a STEM Designation over the next several years.

(l) Support best methods of high-quality professional development for K-12 STEM Education - 63M-1-3204 2 (o)

For four years, STEM AC has supported LEA-designed effective professional learning associated with STEM via the Professional Learning program. Funded projects must align to the Utah Effective Teaching Standards (UETS) developed by the Utah State Board Education (USBE). Additionally, all funded proposals must align with the definition of highly effective professional learning, as defined in HB 320 from the 2014 general legislative session. All grant participants are required to (1) work toward improved STEM-related instruction and (2) film themselves and watch for personalized learning goals through self-reflection.

In FY21, an addition to the external evaluation was made, resulting in a data dashboard, which allows project leadership to see the survey results of their project's participants in aggregate, and compare them to the results of the project across the state. One site leader stated:

"The data dashboard has been an invaluable resource to me this year. I have found it invaluable in guiding important decisions and supporting my own thinking surrounding how to plan and provide better instruction for the teachers in my district."

"I prepared reports for my district leadership on the efficacy of the different types of science professional development we had offered the past couple of years. There are still limiting factors this year due to COVID and other extenuating circumstances that make in-person professional development very difficult this year. Online only professional learning seemed like the only option for science, but it isn't the best option for science learning and I was able to prove that case to district leadership using the data dashboard. It opened up avenues for further discussions and opportunities for blended learning that would have otherwise been not available without data to back up what I was trying to accomplish. Substitutes are still a hurdle we can not climb due to circumstances beyond our control, but seeing data that confirmed why science learning having an in-person learning aspect makes it more effective spoke volumes."

While the impacts on schools associated with the coronavirus were significant, feedback for FY21 was very positive. Suggestions for continued improvement include a need for additional training on how to use data to make instructional decisions, support in differentiating STEM content for all teachers, and continued work establishing the STEM AC as an intermediary organization.

Participant responses regarding the program include the following quotes, provided by the UEPC Professional Learning report for FY21. For additional information, see the full program evaluation provided by UEPC.

"Each time we met was a check-in point more than a meeting, very functional, not a waste of our time... it was, 'What questions do we have? What do we need to do? Who needs to do it? When do we need to have it done by?' and then, 'Let's go do it'... Then our district leader had a couple of Fridays throughout the year where we would meet together...they would share feedback with us, and we would share feedback with them...Sometimes it was logistical, 'this doesn't work' or 'how is this supposed to work?'...There was sharing of ideas, 'How can I put math into this? How can I use a phenomenon is this? How can I integrate this into this?' (interview response)

"The confidence of being able to transition into these STEM subject areas with some degree of real knowledge and expertise is something that's definitely been built" (interview response)

"My knowledge has increased. I've had to do a lot of research to make sure that the curriculum not only met science standards, which I have now become familiar with and didn't know before…" (interview response)

"It's hard to learn how to use data to improve instruction. I'd like more information on that" (survey response)

"I would say that my instructional skills have also increased...because of the video we've had to produce and watch. I mean, when you watch yourself teaching, it's a shock, to say the least." (interview response)

"I think that the support we've received from the STEM Action Center is really the push behind what we've done. I honestly don't think we would have done what we've done [without the grant]. That's just the bottom line. (interview response)

"For me, one of the biggest things was identifying as a STEM educator. Although I identified in many other ways as an educator, I never thought of myself as a STEM educator because I do not teach the sciences...and I don't have in-depth knowledge like a science teacher would. But now I do identify as a STEM educator because I have so many STEM PBLs going along." (interview response)

Over the duration of the project, much has been learned about STEM Professional Learning. Most proposals have focused on developing impactful PLCs, increasing content knowledge, and integrating STEM effectively. In the most recent years, fewer new participants have joined the project. This was an indicator that LEAs around the state interested in STEM professional learning were ready for us to examine the program with an eye for the next iteration.

This resulted in the STEM AC applying for and receiving a capacity building grant as part of the NSF Noyce program. The purpose of this planning grant was to determine if an educator-focused, rather than district focused, would be appropriate for Utah educators. Based on conversations with schools and district leadership, as well as higher education and industry partners, an educator-focused program would be supported and is desired. This program, which will require a five year commitment, will support a cohort of educators in receiving a master's degree if they do not already have one. They will work with subject matter experts to resolve a local problem of practice while developing teacher leader skills. These teachers will become leaders of their peers while staying in the classroom for the duration of the program.

(m) Recognize a high school student's achievement in STEM Fairs, Camps and Competitions- 63M-1-3204, 2 (p)

The STEM AC partnered with several media outlets including FOX 13 and KUTV to highlight some of the exciting STEM projects happening around the state. Highlights include the To-Learn Kits on FOX 13, and a new greenhouse project at Windridge Elementary. Furthermore, the Center highlighted Comcast Lift Zones, an amazing program in partnership with Comcast that brings WiFi hotspots to local community organizations around the state to help close the internet access gap.

In addition to these programs, the STEM AC showcases the work students and educators are doing around the state using website and social media resources. It is the responsibility of the Center to not only promote the work the STEM AC does, but also the work students, educators, companies and communities are doing to support and promote STEM all over the state.

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

In a normal year, pre-coronavirus, the STEM AC reaches out to parents at various STEM events, such as the Craft Lake City DIY fair, STEM expo events, and other sponsored events. Parents are encouraged to sign up for the newsletter and to follow the STEM AC on social media, where they can learn about STEM events across the state and student grant opportunities. The annual STEM Fest provides engaging opportunities for families to attend on the open Family Night. A specific section on the website is dedicated to students, where parents and students both can learn the significance of STEM and also keep up to speed on the latest events.

Toward the end of FY20, the STEM AC and the Utah System of Higher Education partnered to create the Utah STEM Network, a public Facebook page dedicated to creating a community space for people to share resources, inspire innovation and creativity, and welcome dialogue among peers. Whether someone is a K-16 educator, parent, community member, or industry professional, this page will connect with others who share a passion for STEM in Utah.

Again, during a normal year, the STEM in Motion (SIM) team drives the STEM Bus to STEM nights and other events at various elementary schools throughout the year, and opens the bus up to communities to learn more ways to get involved in STEM. Further, the SIM team supports the Leap into Science program that provides STEM and reading events at several community venues across the state. Parents, and their children, are a focus of the Leap into Science program and help to promote reading through engaging topics in science.

(o) 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

In the 2020-21 school year, educators and administrators from 551 schools received professional learning for the use of the K-12 Math Personalized Learning tools as part of the contracts with the product providers. This training ensured that educators were able to integrate the use of the software effectively as a supplement to their instruction.

The STEM in Motion (SIM) team designed and created and distributed 600 STEM kits to teach early learning math and science skills aligned with K-1st grade standards. This was in partnership with Project Child Success out of Washington State, and the three kits used a To Learn model designed originally by Project Child Success. Based on feedback from the initial distribution, an additional 4500 kits have been developed and are currently in the process of distribution. Data on the efficacy of the expanded program will be gathered and assessed by UEPC. The To Learn model incorporates early math concepts into every day fun activities that children enjoy. The pilot kits focused on Paint to Learn, Build to Learn, and Move to Learn. These kits are distributed directly to students without cost, and tie content areas to early math concepts to provide engaging activities for students and important examples for parents. The fourth kit, *Insect Hotel*, was created in partnership with Clever Octopus and focuses on early science skills such as observation and data recording. 130 kits were distributed through the Tooele, San Juan and Kane School Districts as part of an initial pilot program. Initial survey data is positive from the pilot and will be used to develop future early learning kits and programs.

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

Utah Department of Cultural & Community Engagement (CCE)

The Utah Legislature determined that the STEM AC needed to look for a new “home” agency during the 2019 Legislative Session. There were several options considered, such as the Department of Workforce Services, the Department of Cultural & Community Engagement, and the Utah State Board of Education. The final decision was to move the STEM AC to the Utah Department of Cultural & Community Engagement (CCE). There were several factors that supported the choice: the overall governance structure of CCE was appropriate for the STEM AC, the STEM AC already had several project collaborations with divisions of CCE (e.g., the State Library Division and the Division of Utah History), most of the divisions within CCE supported education-based programs and the fund raising function of the STEM AC was aligned to directions desired by the CCE.

The STEM AC Executive Board has the statutory authority to approve a new physical location for the Center and approved the new Columbus Hub of Opportunity for the STEM AC. The Hub is located at 3848 S. West Temple in South Salt Lake and is a mixed use facility for Columbus Serves, a Utah non-profit that provides resources for individuals with differing abilities. The Hub of Opportunity co-locates retail space with approximately 200 affordable housing apartments. The STEM AC is located on the ground level and includes not only office space, but the 2,000 square foot Innovation Hub that will provide a home for community-based FIRST and VEX robotics teams. There will also be new programs that integrate STEM into a variety of areas such as art and STEM innovation. The Innovation Hub will be discussed in greater detail in following sections.

K-16 COMPUTING PARTNERSHIP INITIATIVE

In 2017, with strong support from industry, STEM AC secured $1.255M ongoing to launch the first computing grant initiative in Utah, now known as the K-16 Computing Partnerships Initiative. Since the initiative began, input from STEM AC partners and third-party evaluators have informed funding opportunities and defined the criteria for the grant framework and proposal activities, which address the resource gaps preventing LEAs from offering comprehensive computing programs in K-12. This input has defined a needed shift to a greater focus on integrated computing which can serve a more broad need for earlier and effective engagement. It has also emphasized the strategies of maker spaces activities, work-based learning opportunities, and out-of-classroom opportunities.

FY21-FY23 applicants were required to align with two or more key elements, as defined in the Request for Grants:

- Outreach and student engagement activities through before and after school and summer programs (e.g., robotics and other clubs, innovation/maker spaces, summer camps, etc.)
- Industry involvement, such as mentorship of out-of-classroom programming
- Post-secondary and community collaborations
- Teacher retention opportunities, such as summer externships, mentorship, and other models for increasing skills through professional learning
- Integration efforts between out-of-school programming and classroom learning
- Innovative Pre-K enrichment activities related to computing that emphasize parental involvement and kindergarten preparedness, and activities, which promote equity and access.

The current FY21-FY23 grants were identified through a formal, competitive solicitation, with external review of all submissions. Applicants submitted grant requests for three years of funding. From 37 submissions, 17 grants were awarded. Seventy-one percent of these awards were located outside of the Wasatch Front. Of the $1,092,8
59.59 awarded in FY21, $87,391.62 or 64% were awarded outside of the Wasatch Front. Appendix C provides an outline of the grantees and their funded activities.

Qualitative and quantitative data was collected from grantees in January 2021 and at the end of the school year. Grantee responses identified challenges with implementation that include the postponement or cancellation of planned activities, the unanticipated need to restructure programs or program materials, and inconsistent student participation, primarily due to the coronavirus. Despite these challenges, third-party evaluation analysis provided by the Utah Education Policy Center (UEPC) indicates positive outcomes and provides formative guidance regarding how to improve the program and identify future, additional needs. For more information, see the full report by the UEPC.

During FY21, 1984 students enrolled in 41 new computing class sections, 6624 students participated in out-of-classroom experiences, and 101 students participated in work-based learning opportunities. (Note: students may have participated in more than one activity.) During this same time period, 375 educators participated in professional learning activities.

Grantees identified strategies that best addressed the specific computing needs of their school or district. Educators most frequently identified Out-of-Classroom Experiences (50%) and Innovation & Maker spaces activities (30%) as meaningful for students. (Please note that these two activities were the most common across all grantees.) UEPC reported that the Computing Partnerships grants were associated with numerous positive student outcomes, including computing interest and computing identity.

The majority of educators also reported positive outcomes for themselves. UEPC reported that a common theme expressed by the educators was that professional learning provided the knowledge and experiences needed to engage with computing in their instructional practice. Nearly three quarters agreed with statements of confidence with computing instruction, and the same amount reported positive attitudes toward teaching, as a result of their participation in the Computing Partnerships Initiative. In addition, 85% felt that integrating computing and technology into their instruction was of value.

The following grantee and educator survey and interview responses, as reported by the UEPC, indicate the strong impact of the Computing Partnership activities.

Maker space and Innovation Spaces

- *"Maker space activities that allow students to make something related to the classroom instruction and take it home with them has given them the opportunity to share what they've learned with their family. This has reinforced their learning and lead to conversations at home that promote further learning."*
- *"Seeing their ideas come to life was exciting to them and gave them ownership in our STEM classroom. They could see themselves as future coders and engineers."*
- *"We've always had a mission and vision that our students would be far more engaged with authentic project-based learned, but what we found is with the PBL units, their engagement has been greater than just our emphasis on authentic learning…. And then you combine that with the maker spaces and … I couldn't keep them out of the maker space."*
- *"And so it's opened up this whole new world of what we can do, and not only for the students, but for the teachers."*

Out-of-Classroom Experiences

- *"We were able to connect with more students after school through clubs than in the classroom.*
- *"Students had a chance to spark their interest in a less formal atmosphere."*
- *"…our demographic needs to experience these things when there is no academic pressure on them."*

- *"Out of classroom experiences…cause us to step out of our comfort zones and into more realistic situations."*

Work-Based Learning
- *"I was able to make more of a real-world connection with my high school students."*

- *"Work-based learning - [we are] bringing hope to impoverished kids and showing them a way out of poverty."*

Professional Learning
- *"…professional learning for staff benefitted my students by helping me be a better STEM teacher. I was able to provide varied and engaging activities to my students which helped them be excited about STEM class and STEM subjects."*
    -
- *"I was encouraged to earn the Computational Thinking micro-credentials because of this grant. This has affected by classroom instruction with improved activities, more effective teaching strategies and purposeful implementation of Critical Thinking skills."*

During FY21, the STEM AC provided webinars and connections with technical experts to assist grantees in establishing their maker spaces and meeting specific equipment needs. Identification of additional webinar topics and technical assistance will continue to build the community of practice for grantees and others interested in their projects.

National Science Foundation

Linking Attitudes and Behaviors for Student Success (LABS^2)

The success of key STEM education efforts rely on an effective communication and outreach strategy, with an emphasis on programs that are in Career and Technical Education (CTE). It has been recognized in Utah, as well as in many other states, that CTE programs suffer from myriad negative misperceptions. In order to ensure that any efforts with CTE programs realize their full potential for participation, the stigma that plagues CTE programs needs to be addressed. The STEM AC and partners from higher education, the USBE, several LEAs and the Utah DWS, were awarded funding in 2018 for the Linking Attitudes and Behaviors for Student Success (LABS^2) proposal from the National Science Foundation's Advanced Technology Education (ATE) program. The grant was funded on April 1, 2018 for three years and a total of $766,364. There were significant delays due to COVID-related issues and the grant is now in the first year of a no-cost extension.

The focus of this grant is to work collaboratively to create a new communication and outreach strategy for Career and Technical Education (CTE) programs that is data-driven and utilizes new, and creative communication strategies. There have been two rounds of surveys conducted; the first survey was a general analysis of perceptions and knowledge around CTE programs. The second survey was designed to understand behavior around decision making with students when they consider CTE courses. The data collected from the first survey countered the prevailing assumptions that students do not choose CTE because they have a negative perception or bias against CTE, or that their parents and teachers influence them due their negative perceptions for CTE. The data from 9th and 12th grade students, parents, teachers (CTE and non-CTE) and counselors did not indicate any significant negative biases or perceptions related to CTE. The data clearly demonstrated that the biggest issue that impacted choices for CTE is a general lack of knowledge. The second survey illuminated key findings. Half of the student respondents were equally divided between rational and intuitive decision-making styles. The remaining 50% were divided amongst The new communication strategies, with their messages, will be disseminated for the 2020-21 and 2021-22 school years to determine impact on CTE enrollments and perceptions. An emphasis will be placed on social media deployment. The LABS2 team will follow up with targeted focus groups and additional surveys to assess the impact of the messages and refine them.

Broadening Participation in STEM through Increased Equity, Inclusion, Diversity, and Access
A key focus of the STEM AC is to promote and support equity, access and inclusion to all students. This was a common theme that emerged from stakeholder input during the most recent strategic planning.

The NSF INCLUDES project is a major project in which the STEM AC is a collaborator. A consortium of partners, led by Utah Valley University, initiated the STEM Equity Pipeline in 2014, in partnership with the National Alliance for Partnerships in Equity (NAPE), the STEM AC and Park City School District. The pilot was funded by the National Science Foundation and has been a huge success. The overarching purpose of the STEM Equity Pipeline project is to use root cause analysis to determine the reasons why enrollments for underrepresented populations are unacceptably low in STEM education and career pathways. A pilot was conducted with Park City School District (PCSD) in their middle, junior, and high schools. The first year of root cause analysis was followed by data- driven changes during year two. Year three enrollments for girls in elect STEM courses increased dramatically. Data is being collected for Hispanic and Latino students for year four enrollments. The data from this project is available upon request.

The STEM AC is working with statewide partners to create the STEM Education Equity Coalition (SEEC). The SEEC is a coalition of individuals from organizations that have a commitment to supporting diversity, equity, inclusion and access to STEM through their programs and practices. The SEEC partners will work to create a shared vision, common metrics and collaborative communication strategies. The partners include representation from K-12 and post-secondary education, student organizations and community and cultural partners.

The STEM Equity Pipeline project was completed, but a portion of the project, STEM Micro-Messaging, was found to be extremely useful for district partners. A Motorola Solutions Foundation grant was secured in April of 2018, which has helped to create a modified version of the micro- messaging training that is more scalable with respect to time and cost. The pilot for the modified version was conducted in spring of 2019 with 70 educators in the Davis School District. The workshop was initiated on March 28, 2019, with a full day of training, followed by two months for the participants to test chosen micro- messaging strategies for their classroom. The two months of classroom testing were followed by the second (and final) day of training in June that allowed the educators to share their experience and the outcomes, as well as refine and expand their strategy for the 2019-20 school year. The response from educators was overwhelmingly positive, including the following:

"We made a goal to incorporate a lot of growth mindset lessons, activities, posters, and language in our class. We started off this month by learning about the brain, hippocampus, amygdala, prefrontal cortex, etc. This week we just started having them work for little paper neurons to put on their 'brains' when they do hard things, are persistent, etc."

"We are working together as a PLC. Our focus is to help our students understand that everyone can be a scientist. We are going to start the year with a 'Draw a Scientist' assignment. Students will be asked to draw a picture of a scientist and identify the attributes of their scientist. Then as a group, students will create a poster with a shared idea about what a scientist looks like and specified attributes. Then students will display their posters around the classroom and we will have a group discussion about the commonalities and differences in the pictures. We want to lead the students to identify missing attributes or if anyone feels like these pictures don't represent them. We will share an experience from Edwin Hubble where he 'reinvented himself' in order for other scientists to take him seriously by changing his look and behaviors to look more like an expected scientist. Throughout the rest of the semester we will highlight under- represented scientists each month, focusing on females and scientists of color. We will also work on developing a 'biography of a scientist' project for students to complete that will also place a focus on underrepresented scientists. We are also going to modify our 'cold call' techniques in the classroom. We will have cards or sticks with student names and we will actually separate them into piles based on gender. This will allow us to alternate calling on girls and boys so that it is equally done in the class. (One teacher) also noted that she focused on providing feedback to both boys and girls and not just to boys. At the end of the semester we will revisit our first assignment of drawing a scientist. Students will go back to their original groups and reflect on how their idea of a scientist has changed (or not). As a group, they will add to or create a new drawing of a scientist and list the particular attributes, with the hope that students' ideas will be more inclusive by the end of the semester."

The work initiated by the STEM Equity Pipeline expanded to a two-year planning grant in the NSF INCLUDES program, Intermountain STEM (IM-STEM). The IM-STEM project is a collaboration between the National Alliance for Partnerships in Equity (NAPE), Utah and five other Intermountain West states (Colorado, Idaho, Wyoming, Nevada and New Mexico). The IM-STEM project focused on establishing a network of STEM leaders and state initiatives that collectively gathered best and promising practices in STEM education that broadened participation in STEM education. A key deliverable from the project was a STEM Equity Evaluation Rubric that helps to assess programs in their effectiveness of building out practices that are inclusive and provide equitable access to all students.

The IM-STEM project concluded in June 2020, but the IM-STEM team, in collaboration with a national team, has were awarded a planning grant to the NSF INCLUDES program to prepare for a full national INCLUDES Alliance. The Utah STEM AC is a co-lead on the national alliance planning grant and the intent is for the STEM AC to be the regional hub for the western US for the national alliance proposal.

Strategic planning - the next 3-5 years
The STEM AC embarked on an intensive strategic planning process in January of 2020, which was completed in April of 2021.

The strategic planning process included a series of stakeholder focus groups, one on one interviews and community surveys. Logic models, which are part of the evaluation process for all STEM AC projects, were adapted to the data collected during the planning process. The plan can be found at the following link: https://stem.utah.gov/strategic-plan/

Distance Learning
The STEM AC has always had a strong commitment to access and equity, with a focus on rural students and communities. The challenges that the COVID-related issues has created only amplifies the need for greater innovation and capacity for distance learning.

The STEM in Motion team, as previously discussed, has adapted all of the classroom instruction programs to a blended learning model, with kits that can be checked out. The adaptation of the in classroom instruction to kits, combined with remote instruction resulted in increased impact to rural and remote communities.

The Innovation Hub will provide numerous ways to offer workshops, courses, professional learning and technical assistance to every community in Utah using blended virtual and in person opportunities. The efforts to create a state wide Innovation Hub Network will result in satellite partner locations across the state to support local and regional programs.

Outreach, Engagement and Partnerships
The STEM AC conducts the following outreach and engagement activities as a means to provide project support to educators and promote STEM AC resources. There are numerous outreach, engagement and partnership development activities that are included in previous sections, such as the industry engagement portion of the report.

The Director of the STEM AC conducts visits with district superintendents, and has been working to create a STEM AC Advisory Board with district superintendents. The intent is to resume the effort when the challenges of COVID have diminished.

The STEM AC continues to build relations with school boards including the Rural School Boards Association. The STEM AC has committed to attending the Rural School District Association meetings to understand more fully how to support rural districts and their STEM needs. The STEM AC has spent a great deal of time working with the Regional Education Service Centers (NUES, CUES, SESC and SEDC). The Utah STEM in Motion team works with the rural service centers to provide access to the kits that they have developed.

The STEM AC continues to work with the USBE as part of a STEM Advocacy Team that has recently released its first collaborative communication document that helps to clarify roles and partnerships between the STEM AC and the USBE.

The STEM AC conducts site visits to various projects over the year. The following are examples of how the STEM AC team works to engage with partners across the state.

Classroom grants for the 2019-20 school year varied in scope and subject. While team members typically visit classroom grant recipients heavily in the months of March-May, these visits were not able to take place due to schools moving to distance learning formats in response to coronavirus. As such, only one visit was completed for the classroom grant program. Of the 121 grants awarded 51 awardees were not able to fully implement their projects, also due to coronavirus disruptions. These grant awardees were given contract extensions to allow them to complete their proposed curricular changes and complete the grant reporting requirements in the 20-21 school year. The remaining program participants were able to complete their proposed projects and all associated reporting components. Greater detail regarding the classroom grants program can be found in preceding sections.

School visits were completed for the six new STEM School Designation recipients at the gold or platinum levels in the 2019-20 school year. Due to limitations in place to control the spread of coronavirus, school visits were not made in the 2020-21 school year for STEM School Designation purposes.

STEM AC participated in the grand opening of the Windridge Elementary interactive STEM Lab, sponsored in part with STEM AC funding. Converted from a previous computer lab, the new maker space's hands-on activities include building miniature robots, working with a 3D printer, and making films with a green screen. Principal Casey Pickett believes this new lab helped the school receive a platinum STEM designation from Utah STEM Action Center in May of this year.

The STEM Team also participated in the third annual Family STEM Night hosted by USU Extension Kane County 4-H and Kane Education Foundation at the new Kanab center. STEM AC helped to sponsor this event and also hosted one of 20 hands-on learning booths, which reached approximately 650 people including almost 500 students. The next day staff members toured Kanab's community maker space, and elementary and high school classes. Kane County School District is a recipient of the Computing Partnership Grant program.

The STEM in Motion (SIM) team focuses on in-classroom instruction, giving both the students and educators a hands-on experience of STEM. In the last three years, the SIM team has spent over 1,000 hours in classrooms, working with these students to develop a passion for STEM starting in elementary school. The SIM team also works with educators to bolster their confidence and knowledge base to consistently teach high-quality STEM lessons in their classrooms.

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

The STEM AC completed its eighth full year of training and implementation to support the K-12 Math Personalized Learning program (2020-21 school year). The overall goal of this program is to provide supplemental math support to educators and students in an innovative approach that includes: (1) ongoing research of best practices in the use of supplemental instructional tools (2) using a statewide approach to design and implement a robust analysis of the use of content-specific supplemental technology-based tools and (3) a statewide approach to implement a program that leverages state contracting and critical mass for cost-effective access and (4) integrating a mechanism that allows for continuous assessment of new products at no cost to the state.

A total of 164,430 students had access to licenses provided by the STEM AC for math personalized learning tools. The program covered 25% of all Utah students in grades K-12, with 34 districts and 60 charter schools participating (551 schools total). Seven math personalized learning products were used during the 2020-21 school year. Buy-in at all levels is critical to success, and for each application a signature from one district-level admin and one school-level admin is required. Admin promised to ensure that students have access to technology for at least 45 minutes per week to use the math software provided. We also required signatures from the IT Director at each LEA to ensure they were aware of any technology provided by the grant and that they would have adequate bandwidth and infrastructure prior to implementation. Each year we require on-site professional learning opportunities for classroom educators to increase buy-in at the teacher level and ensure classroom teacher participants are comfortable with the products they will be using over the course of the year.

All applications are required to list “on- site” contacts, which are verified by the district point of contact before the beginning of the school year. This ensures that product providers are able to distribute the majority of awarded licenses and facilitate professional development right at the beginning of the school year. Product providers are required to distribute licenses and arrange professional development before they receive payment, which has encouraged them to put forth extra effort to ensure timely completion of these activities. We also made sure that usage expectations were clearly communicated to administrators and math coordinators.

To allow school and district administrators to more strategically plan implementation, we open the application for the following school year early in the spring and send award notifications in April before budgets have to be completed.

As this program has matured, we have found there is a difference between “fidelity”- using a product for a certain amount of time - and effective implementation. When working to ensure products are used effectively with over 100 thousand students, the easiest metric to look at is minutes of use. While we know that greater usage is correlated with greater student achievement, this metric does not provide a complete picture of what effective usage looks like. Over the past couple years, we have learned human connection is the single most significant factor related to student performance in math. As we have worked to emphasize the importance of using these supplemental products strategically to facilitate better human connection between educators and students, administrators all over the state have expressed their support for this approach and their gratitude toward the STEM AC for understanding the important role of the teacher in high quality math instruction.

Year after year, class sizes grow and it becomes increasingly difficult for students to get the direct attention that will help them reach grade-level proficiency. Few resources are specifically designed to target the needs of struggling students who aren't identified as students with special needs. As a result, they slip farther and farther behind until, by eighth grade, in spite of consistent positive impacts of software over the past 8 years, only 37% of Utah students are reaching grade-level proficiency. That puts Utah in the top 10 best performing states in math, but we still have a lot of work to do. Math is the biggest predictor of students' future academic and career success, even after controlling for reading skills, attention skills, socio-economic status, and socio-emotional behaviors, and eighth grade is the 'deadline' that most accurately predicts success in college and beyond.

The biggest obstacle to fostering greater human connection around mathematics in schools has been an insufficient number of adults in Utah classrooms. In FY20, the STEM AC received an Americorps planning grant for a program designed to bring Math Mentors into classrooms and in FY 21, AmeriCorps awarded the STEM AC a full operational grant to build out the program. Mentors will be getting into classrooms to kick off the program through out the 2021-22 school year. This program represents the next step for the K-12 Math Personalized Learning program, working with AmeriCorps members and industry partners to provide evidence-based interventions to Utah students who are struggling in math. AmeriCorps members provide in-school mentoring in grades 4-8 using math personalized learning software to help students improve math performance and build important skills for academic and career success. This program helps local communities respond to gaps in education amplified by the Covid-19 pandemic, while actively addressing and removing inequities, including those related to race, gender, educational outcomes, and digital inclusion. Half of the program efforts are in rural communities with limited resources and infrastructure, delivering measurable service and significant impact to areas of greatest need. AmeriCorps members also facilitate recruiting and training of local volunteers to build capacity and sustainability.

The main purposes of this project are to: 1) increase the number of Utah students reaching grade-level proficiency in mathematics, 2) improve students' confidence and persistence in mathematics, and 3) sustainably increase the number of mentors in classrooms.

As we worked with community partners and stakeholders throughout the state to complete our new strategic plan, another gap in math education became apparent. Stakeholders indicated that there is a dearth of STEM early learning resources for children aged 2-5, particularly in Math.

This is particularly concerning, because research indicates that math scores entering kindergarten are the most significant predictor of future math scores, reading scores, and long-term academic and career outcomes. Kindergarten math entry scores are a more reliable predictor than socioeconomic factors, disability status, and socio emotional and behavioral factors, which are frequently highlighted as some of the most significant predictors of long-term success.

The beliefs, practices, and language of parents and caregivers almost completely explain gaps in student's symbolic and conceptual knowledge of the number system and spatial awareness when entering kindergarten. Research shows that gender differences in early math achievement are completely mediated by adjusting the spatial language parents use to talk to their children, and that parents have a significant impact on whether kids feel they are capable of being successful in math.

Despite this, parents and caregivers often lack access to high-quality STEM resources and information about how to help their children gain the skills needed for academic success. Often societal messaging about math can be detrimental to early confidence for girls and children from minority backgrounds. Addressing the awareness of cultural, racial, and class biases is important to how STEM participation is encouraged and nurtured in children. Children have a natural curiosity, and they need adults to foster and guide their STEM abilities.

In FY21, with donations from Boeing and other partners, the STEM AC created Paint to Learn, Build to Learn, and Move to Learn kits targeted at supporting fun, math focused interactions between children ages two to eight and their caregivers. Over 5000 kits have been distributed or are in the process of distribution. These kits are distributed directly to students without cost, and tie content areas to early math standards established and approved by USBE. Kits are designed to make math fun and engaging so that students develop positive attitudes about math and confidence in their own ability to think mathematically. In addition, these kits provide examples for caregivers about how to talk about math and make math a fun part of everyday activities.

In FY22 The STEM AC will begin working with the CCE marketing and design team, to create a widespread mathematics program systematically designed to empower families to engage with their children in ways that promote the development of numeracy between infancy and age five.

Third-party evaluation report on performance of students participating in STEM Action Center programs as collected in Subsection 63M-1-3204(4).

The STEM AC continues to work with the Utah Education Policy Center (UEPC) to expand beyond basic metrics, to facilitate a more robust analysis that provides greater stratification of the data, as discussed previously.

UEPC will work with the USBE, mentors, and educators to identify promising practices, assess the relationship between program participation and end-of-year test scores, and understand attitudes and perceptions of teachers, mentors, and students related to this program. Impacts of the new programs centered on math early learning will also be evaluated.

The third-party evaluator has completed the annual report that includes assessment of the Professional Learning and Computing Partnerships and these reports can be found in Appendices D and E.

ATTACHMENTS:

Appendix A: Selected Product Providers
Appendix B: Community Impact - Sponsorships
Appendix C: Computing Partnership Grant Partners
Appendix D: Computing Partnership Evaluation
Appendix E: Professional Learning Evaluation

REFERENCES:

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Motoko, A. and Guodong, L. (2016). Effects of teacher professional learning activities on student achievement growth, The Journal of Educational Research, 109:1, 99- 110.

Selected Product Providers

Appendix A

HB Project	Vendor	Alignment
K-12 Math Personalized Learning	- Curriculum Associates (i-Ready) - Dreambox Learning - Imagine Learning (Imagine Math) - McGraw-Hill (ALEKS) - Mathspace - MIND Research Institute (ST Math)	✓ 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

Organization	Program
USU Sanpete County	Sanpete County 4-H STEM Outreach Program
SESC	Southeast Education Service Center STEM Kit Program
Utah Science Teachers Assoc.	Cultivating SEEd in Diverse Environments
Shadow Valley Elementary	WSU and Shadow Valley "Green" Goblin Collaboration
Alliance for Innovative Education	Alliance Learning Center
Dixie State University	Dixie PREP
Utah Division of State History	History Day Awards
Youth Impact	Experiencing Engineering with Drones
Tooele County School District	Camp Invention Program
USU Extension Salt Lake 4H	4H Outreach
Jordan School District	Jordan PREP
USU Extension	AgriScience Outreach
Boys and Girls Club of Salt Lake	STEM Youth Development Program
Utah Valley University	Impowering Inventors with Micro Bits
Dixie State University	DSU STEM Girls
Bryce Valley Elementary	
Jordan Academy for Tech and Careers	STEM Literacy Packs
Promise SSL	Computer Center

FY 21-23 Computing Partnerships Initiative Grantees

	K-6				(6) 7-8 (9)				9-12					
	Makerspace	Out-of-Classroom	Prof. Learning	Integration	Maker Space	Out-of-Classroom	Prof. Learning	Integration	Makerspace	Out-of-Classroom	Prof. Learning	Near Peer	Internships	Industry Certs
CUES (7 LEAs)		●	●		●	●	●		●	●	●			
Duchesne School District (4 Elem)	●	●	●											
Entheos Academy/Pacific Heritage (Charter) (3 campuses – Elem and Jr)	●	●	●	●	●	●	●	●				●		
Granite – Kearns (2 Elem, 1 Jr, 1 HS)	●	●	●		●	●	●		●	●	●			
Iron County School District (9 Elem, 3 Mid)	●	●	●	●	●	●	●	●						
Jordan School District (39 Elem, 12 Mid, 6 HS)	●	●	●	●	●	●	●	●	●	●	●			
Juab School District (12 Elem Staff)	●		●											
Kane School District (2 Elem, 1 Jr, 1 HS)	●	●	●		●	●	●	●	●	●			●	

Murray School District (3 Elem, 2 Jr, 1 HS)	●	●	●		●	●	●					●	●	
Pinnacle Canyon Academy (Charter)	●			●		●				●			●	
San Juan School District (12 schools)	●	●	●		●				●	●				
SEDC (6 LEAs-HS)													●	●
S. Sanpete- Manti Elem (1 Elem)	●		●											
Washington School District (4 Elem, 1 Jr)		●	●									●		
Washington SD – Hildale (650 students, K-HS)		●	●			●	●			●	●			
Weber School District (25 Elem, 9 Jr/HS)		●	●			●	●			●	●			
Weilenmann School of Discovery (Charter) (Elem and Jr)	●		●		●		●							

2021

Broadening Participation in Computing in Utah: An Evaluation of the STEM Action Center's Computing Partnerships Grant Program (2020-21 School Year)

Prepared by the Utah Education Policy Center
on behalf of the STEM Action Center

October 2021

THE UNIVERSITY OF UTAH
UTAH EDUCATION POLICY CENTER

Bridging Research, Policy, and Practice

The Utah Education Policy Center (UEPC) is an independent, non-partisan, not-for-profit research-based center at the University of Utah founded in the Department of Educational Leadership and Policy in 1990 and administered through the College of Education since 2007. The UEPC mission is to bridge research, policy, and practice in public schools and higher education to increase educational equity, excellence, access, and opportunities for all children and adults.

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The UEPC thanks Lynn Purdin from the STEM Action Center for providing essential insights about the Computing Partnerships Grant and serving as a liaison between the evaluation team and the STEM AC partner schools and districts. We appreciate the time educators and students from participating districts provided to offer feedback on their experiences with the Computing Partnerships Grant Program

Table of Contents

Tables and Figures

Introduction

Computing Partnerships Grant Program Overview

In 2017, Senate Bill 190 (S.B. 190), passed in the Utah State Legislature, created the Computing Partnerships Grant Program. The grant program, as described in the bill text, is to fund “the design and implementation of comprehensive K-16 computing partnerships” (S.B. 190, lines 71-72). Computing partnerships that meet the criterion of comprehensiveness, as S.B. 190 further specifies, are those that intend to enhance outreach and engagement, course content and design, work-based learning opportunities, student retention, professional learning, access, diversity, and equity, and institutional, industry, and community collaborations. The Computing Partnerships Grant Program intends to expand computing opportunities for students and educators in Utah. Public PK-12 districts and schools can apply for grants that allow them to provide and expand computing programs. Grantees are encouraged to increase access to underserved populations and focus on activities that occur outside of the traditional classroom setting.[1] In funding these partnerships, the overarching goal of the grant program is to support students’ acquisition of skills and knowledge necessary for success in computer science, information technology, and computer engineering courses and careers.

The Utah Education Policy Center’s (UEPC) 2020-21 evaluation of the Computing Partnerships Grant Program used a mixed-method design (i.e., interviews, surveys, and secondary data sources) to answer the following research and evaluation questions:

- What are the observable characteristics (e.g., race/ethnicity, gender, degree attainment) of educators who participated in the Computing Partnerships Grant Program?
- How effective are Computing Partnerships Grant activities at increasing educators' computing competence (particularly with aligning curricula with CS standards), confidence, job attitudes/satisfaction, and value of computing?
- What factors support and impede educators' computing competence (particularly with aligning curricula with CS standards), confidence, job attitudes/satisfaction, and value of computing?
- How did educators provide continuity for programming during the COVID-19 pandemic?
- How effective are Computing Partnerships Grant activities at increasing students’ computing self-efficacy, interest, engagement, skills (as aligned with Utah’s CS standards), computational thinking, awareness of computing career opportunities, and intentions to pursue computing?
- How well were the program elements of the Computing Partnerships Grant implemented and adapted at each LEA to support students’ computing self-efficacy, interest, engagement, skills (as aligned with Utah’s CS standards), computational thinking, awareness of computing career opportunities, and intentions to pursue computing?
- To what degree has each LEA met its goals and objectives for the Computing Partnerships Grant?
- How effective are *post-secondary, industry, and community collaborations* at supporting program objective and goal attainment?
- In what ways and to what extent has the STEM AC supported the development and expansion of computing in schools—teacher and school capacity, practice, and scaling up?

A total of 17 projects were funded by the Computing Partnerships Grant Program during the 2020-21 school year. Projects identified objectives and outcomes to guide their work. A summary of these

[1] https://stem.utah.gov/educators/opportunities/computing-partnership-grant/

measures is located in Appendix A. Although there were a range of topics captured in projects' objectives and outcomes, projects primarily noted goals related to educator learning and training (10 of 17) and partnerships and collaborations (6 of 17). Other common areas included afterschool activities, underserved student populations, and the creation of new learning spaces.

Relevant Literature

As noted in a recent Utah Education Policy Center (UEPC) evaluation of the Computing Partnerships Grant Program,[2] research to date has highlighted the following:

- Computing technologies are critical for the United States' economy. In particular, these technologies are critical to fields such as information technology and other digital careers, healthcare and even the automotive industry (Jeffers et al., 2004; U.S. Congress Joint Economic Committee, 2012). In order for the nation to continuing growing in these fields, it is imperative that individuals acquire skills in STEM (science, technology, engineering, mathematics) fields (Blikstein; 2018; President's Council of Advisors on Science and Technology, 2012).
- Job growth is expected in STEM fields throughout the United States and in Utah specifically (U.S. Bureau of Labor Statistics, 2020; Utah Department of Workforce Services, 2018). Despite this demand, the United States is not training enough individuals to work in STEM positions (Sanzenbacher, 2013).
- One strategy for advancing the nation's STEM labor force is increased investment in computer science education in K-12 schools (e.g., (Joshi & Jain, 2018; Leyzberg & Moretti, 2017; Papini et al., 2017). Sanzenbacher (2013) found that K-12 educational settings are expanding computer science opportunities through job shadows, externships, and guest lectures by individuals from the field.
- Despite increased attention to computer science education, there are disparities in access. Students of color are less likely to participate in dedicated computing courses than their White peers, regardless of socioeconomic status (Google Inc. & Gallup Inc., 2015; Qazi et al., 2020). Similarly, girls are less likely than boys to study computer science (Google Inc. & Gallup Inc., 2016), and rural students have less access to computing opportunities (Google Inc. & Gallup Inc., 2015).
- Educators play a critical role in students' STEM outcomes. Most computer science teachers in U.S. K-12 schools do not hold a degree in computer science (Leyzberg & Moretti, 2017), which is a hindrance to student learning (Leyzberg & Moretti, 2017). It follows that educators providing computing instruction to students would likely benefit from increased support and professional learning. This might occur through collaborations with post-secondary institutions (e.g., Sanzenbacher, 2013) or other industry experts (e.g., Papini et al., 2017).
- STEM identity, confidence, and competence are intertwined (Carlone & Johnson, 2007; Herrara et al., 2012; Oyserman, 2015; Perez et al, 2014). To enhance these characteristics, both educators and students can benefit from exploration of their STEM interests and engagement with STEM content. STEM programming, which offers intentional STEM experiences, cultivates STEM efficacy.

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[2] Onuma, F. J., Rorrer, A. K., Pecsok, M., Tsagaris, M. (2020). *Broadening Participation in Computing in Utah: An Evaluation of the Impact of the Computing Partnerships Grants Program.* Utah Education Policy Center: Salt Lake City, UT.

Methods

Evaluation Questions

This mixed-methods evaluation used interviews, surveys, and secondary data sources to answer research and evaluation questions about the outcomes resulting from the Computing Partnerships Grant Program. We structured our research/evaluation questions and findings around four central topics – educators' experiences and competencies in computing, students' experiences and outcomes, LEA implementation and adaptions, and external support for program implementation. Table 1 contains a summary of the research/evaluation questions and data sources used to inform our analysis.

Table 1. Research and Evaluation Questions and Data Sources

		Data Sources						
	Research and Evaluation Questions	**STEM AC Personnel Interviews**	**Educator Interviews**	**Partner Interviews**	**Student Survey[3]**	**Educator Survey**	**Grantee Survey**	**Secondary Data**
	Educators' Experiences and Competencies in Computing							
Research Questions	What are the observable characteristics (e.g., race/ethnicity, gender, degree attainment) of educators who participated in the Computing Partnerships Grant Program?							✓
Evaluation Questions	How effective are Computing Partnerships Grant activities at increasing educators' computing competence (particularly with aligning curricula with CS standards), confidence, job attitudes/satisfaction, and value of computing?	✓	✓			✓		
Evaluation Questions	What factors support and impede educators' computing competence (particularly with aligning curricula with CS standards), confidence, job attitudes/satisfaction, and value of computing?		✓	✓		✓		

[3] The UEPC Student Computing Survey was newly constructed this year to address implementation and outcomes for students. Because this was the first year of administration, a pilot administration was conducted in a single district.

	Research and Evaluation Questions	Data Sources						
		STEM AC Personnel Interviews	Educator Interviews	Partner Interviews	Student Survey[3]	Educator Survey	Grantee Survey	Secondary Data
	How did educators provide continuity for programming during the COVID-19 pandemic?		✓			✓	✓	
	Students' Experiences and Outcomes							
	How effective are Computing Partnerships Grant activities at increasing students' computing self-efficacy, interest, engagement, skills (as aligned with Utah's CS standards), computational thinking, awareness of computing career opportunities, and intentions to pursue computing?	✓	✓		✓	✓		
	LEA Implementation and Adaptations							
	How well were the program elements of the Computing Partnerships Grant implemented and adapted at each LEA to support students' computing self-efficacy, interest, engagement, skills (as aligned with Utah's CS standards), computational thinking, awareness of computing career opportunities, and intentions to pursue computing?		✓			✓		
	To what degree has each LEA met its goals and objectives for the Computing Partnerships Grant?		✓				✓	
	External Support for Program Implementation							
	How effective are *post-secondary, industry, and community collaborations* at supporting program objective and goal attainment?		✓	✓				
	In what ways and to what extent has the STEM AC supported the development and expansion of computing in schools—teacher and school capacity, practice, and scaling up?		✓	✓		✓	✓	

Data Sources & Analysis

UEPC Educator Computing Survey

Districts and schools participating in the Computing Partnerships Grant Program identified 297 educators to participate in a UEPC Educator Computing Survey. In the spring of the 2020-21 school year, these individuals, who were identified based on their knowledge of and experience with the Computing Partnerships Grant Program, were invited via a direct email to complete the survey. The UEPC Educator Computing Survey contained questions designed to assess the competencies that educators developed as a result of their participation in the program, student outcomes, program implementation, and perceptions of the STEM Action Center.

All survey items were on a five-point scale intended to measure either agreement or perceived competency. For items intended to measure agreement, a scale ranging from “strongly disagree” to “strongly agree” was used, where strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4, and strongly agree = 5. For items intended to measure perceived competency, a scale ranging from “not at all competent” to “completely competent” was used, where not at all competent = 1, slightly competent = 2, somewhat competent = 3, quite competent = 4, and completely competent = 5. Within each of the topics included in the survey, we calculated average responses on a five-point scale. In the case of items measuring agreement, we also calculated the proportion of responses that were either “agree” or “strongly agree.”

The majority of survey items were asked of all participants. A subset of items, however, was tailored to specific grant activities. Each of the 17 Computing Partnerships projects participated in two to six of seven possible grant activities.[4] As such, educators were only presented with items pertaining to the grant activities that their projects were involved with. For example, if a project engaged in Out-of-Classroom Experiences, Near-Peer Mentorship, and Work-Based Experiences, educators affiliated with that project only responded to survey items related to those activities. Competencies associated with each grant activity were assessed through three to five survey items, and the number of respondents for each bank of items ranged from 45 to 116.

The specific content of the UEPC Educator Computing Survey is presented in more depth in our presentation of findings. Analysis of these items included the generation and interpretation of descriptive summary statistics to identify common trends in responses across topics. In the case of three open-response survey items asking respondents to provide additional context about their experiences, we used open coding to categorize responses, then further identified common themes across responses. Quotes are used to provide examples that further elucidate these themes.

We received 174 responses, representing a 59% response rate. Through de-identified *Comprehensive Administration of Credentials for Teachers in Utah Schools* (CACTUS) records, which are described in more detail below, we generated a summary of participants’ observable characteristics in our presentation of findings in response to our first research question. Of the 174 individuals who participated in the educator survey, CACTUS data records were available for 124. Of the remaining 50 individuals, 33 did not have a CACTUS ID and 17 did not appear in CACTUS records. Because some educators participating in the Computing Partnerships Grant Program are unlicensed educators (e.g., afterschool program

[4] The seven Computing Partnerships Grant Program activities were: Innovation & Makerspaces, Out-of-Classroom Experiences, Integration of Out-of-Classroom Experiences and Classroom Instruction, Near-Peer Mentorship, Work-Based Learning Experiences, Professional Learning for Teachers and Staff, and Post-Secondary, Industry, and Community Collaborations.

providers, paraprofessionals), they did not appear in CACTUS data records. In other cases, districts/schools may have provided incorrect IDs that did not match with USBE records. Survey responses provided by those without CACTUS IDs were included in our analyses, with the exception of our description of educators' observable characteristics, as this description relied upon CACTUS data.

UEPC Student Computing Survey

A UEPC Student Computing Survey was piloted in a single district during the 2020-21 school year. This survey intended to measure students' computing self-efficacy/self-confidence, computing interest, computing engagement, computational thinking (including abstraction, algorithmic thinking, decomposition, pattern recognition, and evaluation), and computing identity (including recognition, interest, performance/competence, and goal/outcome expectation). Each of these constructs was measured using anywhere from two to 12 survey items. All survey items were on a five-point scale ranging from "strongly disagree" to "strongly agree." Within each of the topics included in the survey, we calculated the average response where strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4, and strongly agree = 5. We also calculated the proportion of responses that were either "agree" or "strongly agree." Further interpretation is provided in our presentation of findings. Only nine responses from middle school and high school students in one district's summer program occurred. In the 2021-22 school year, the UEPC will offer this survey to all students who are part of Computing Partnerships programing. Future analyses of the UEPC Student Computing Survey will include factor analysis to further refine the instrument.

UEPC Grantee Survey

Grantees from each of the 17 Computing Partnerships programs participated in a fall and spring UEPC Grantee Survey. This questionnaire collected information from grantees about the numbers of participating students and educators, progress on program objectives, and feedback about their work with the STEM Action Center. The UEPC provided these results to the STEM Action Center in an interactive data dashboard to allow STEM Action Center personnel to view program results in an accessible format. Grantees were also provided with access to their own individual responses along with aggregated responses for all programs. While the electronic dashboard is the primary format for these data, this evaluation report provides a synthesis of select data from the UEPC Grantee Survey. Specifically, we summarize progress on grant objectives, barriers related to progress, and feedback about the STEM Action Center. These data are analyzed through the calculation of summary statistics and through open coding of open-response survey items to identify common themes and example quotes.

Interviews

Interviews were planned with a STEM Action Center representative, STEM Action Center partners, and educators. The purpose of these interviews was to gain a deeper and more nuanced understanding of how the Computing Partnership Grant Program was implemented from the perspective of those in the field. A semi-structured interview protocol was developed to gather information about participants' experiences with implementation as well as suggestions for improving the grant program and for future planning. Respondents to the UEPC Educator Computing Survey were asked if they would be interested in participating in an interview. Of the survey respondents, 22 participants indicated an initial willingness to participate in a follow-up interview. Two educators responded to the invitation to voluntarily participate in an interview and completed consent forms prior to the interview. In addition, the UEPC was able to interview one representative from the STEM Action Center. Grantees were asked to identify partners they worked with this year. Of those identified, 17 Computing partners were invited to participate in interviews. Five responded to the invitation to voluntarily participate in follow-up interviews. Interviews ranged from approximately 45 minutes to one hour. All interviews were conducted virtually via Zoom, and each was recorded and transcribed for analysis.

Analysis of interviews included the use of both open-coding and focused-coding based on the evaluation questions to generate themes (Saldaña, 2016). Due to the small interview participant sample size, we have integrated example interview quotes throughout this evaluation report, rather than presenting a standalone analysis of interview findings.

Secondary Data

The UEPC used CACTUS data, as permitted through the UEPC DSA with USBE, along with publicly available school data, to generate summary characteristics of Computing Partnerships Grant Program participants and sites. All characteristics were analyzed and presented in an aggregated format to protect the privacy of participants. These data allowed us to identify any differences in experiences with the program by educator characteristic or school setting.

Educators' Experiences and Competencies in Computing

In *Educators Experiences and Competencies in Computing*, we present our findings for one research question and three evaluation questions pertaining to Computing Partnerships educators. Specifically, we discuss the observable characteristics of participating educators, educators' outcomes and the factors that supported or impeded those outcomes, and the extent to which educators provided continuity during the COVID-19 pandemic. To address these topics, we considered a variety of data sources, including CACTUS records, survey data, and interview data. Specific data sources are discussed in more detail in our presentation of findings. Findings are organized by research/evaluation question.

Educators' observable characteristics largely mirror those of Utah educators as whole

What are the observable characteristics (e.g., race/ethnicity, gender, degree attainment) of educators who participated in the Computing Partnerships Grant Program?

Computing Partnerships educators' observable characteristics generally mirror those of Utah as a whole. As shown in Table 2, individuals who participated in the UEPC Educator Computing Survey were primarily female (77%) and White (93%). Statewide, educators were primarily female (67%) and White (90%). About half of participants held a bachelor's degree, while the remaining either held an advanced degree (38%) or their educational attainment was unavailable in CACTUS records (11%). Educational attainment was similar, with approximately half of educators statewide holding graduating degrees. Most participants held regular teaching licenses, and experience levels varied. Computing Partnerships educators were, however, less likely to hold regular teaching licenses (76% vs. 90%), which is likely due to the fact that Computing Partnerships educators often serve in positions outside of a traditional classroom setting (e.g., out-of-classroom programming). Computing Partnerships educators were more likely to have more than five years of classroom experience. As a reminder, these observable characteristics reflect participating educators with CACTUS IDs. Educators without CACTUS IDs are not reflected in this description of observable characteristics. They are, however, reflected throughout the remainder of this report as we address our remaining evaluation questions.

Table 2. Observable Characteristics of Computing Partnerships Educators and All Utah Educators

Participant Characteristic	CP Educators with CACTUS IDs	All Utah Educators
Gender		
Female	77%	67%
Male	23%	33%
Race/Ethnicity		
White	93%	90%
Other racial ethnic group or unknown*	7%	10%
Educational Attainment		
Bachelor's degree	51%	53%
Master's degree or higher	38%	43%
Other	11%	4%
License Type		
Regular classroom level educator	76%	90%
LEA level educator	9%	3%
Underqualified** or unknown	15%	7%
Teaching Experience		
Five or fewer years	43%	53%
Six to ten years	18%	13%
More than ten years	20%	17%
Unknown	19%	17%

**To protect the identities of participants, groups of participants fewer than 10 individuals were aggregated together.*
***Underqualified is a term provided by USBE to describe individuals with one of the following licensure types: student, para, ARL, temporary license, C, or no license.*

Educators reported positive outcomes as a result of their participation in the program

How effective are Computing Partnerships Grant activities at increasing educators' computing competence (particularly with aligning curricula with CS standards), confidence, job attitudes/satisfaction, and value of computing?

Educators reported high levels of competency in their ability to seek ways to improve their professional practice

As part of the UEPC Educator Computing Survey, all respondents were asked to rate their competence in three areas:

- Seeking ways to improve their professional practice
- Computing/technological competence and practices
- Promoting diversity through inclusive practices

Participants responded to four to seven items in each area, as noted in Table 3. For each item, participants rated their competency by selecting one of five options: "not at all competent," "slightly competent," "somewhat competent," "quite competent," or "completely competent." We calculated the percentage of responses that were either "quite competent" or "completely competent" in each area and refer to these responses collectively as "Highly Competent." For example, 88% of responses pertaining to professional learning were rated as either "quite competent" or "completely competent," whereas in the other two competency areas, computing/technological integration and promoting diversity through inclusive practices, "Highly Competent" rates were lower at 69% and 61%, respectively.

Table 3. Educators' Self-Reported Competencies

Competency Area	**Number of Survey Items**	**Sample Item**	**Percentage Highly Competent**
Seeking Ways to Improve Professional Practice	5	• *I am willing to share teaching problems with others.* • *As an educator, I know how to learn to improve my teaching.* • *I have knowledge on how to cooperate with others.*	88%
Computing/Technological Competence and Practices	7	• *I am open to modifying my pedagogical practices as needed to integrate technology.* • *I can adapt the use of technologies to different teaching activities.* • *I can select appropriate computing applications to enhance student learning.*	69%
Promoting Diversity through Inclusive Practices	4	• *I often promote diversity through the behaviors I exhibit.* • *I examine the instructional materials I use for racial and ethnic bias.* • *I have a clear understanding of culturally responsive pedagogy.*	61%

*Highly Competent = Proportion of responses that were either rated as "Quite Competent" and "Completely Competent."

Open-ended survey responses and interview data provided additional insights about the ways in which educators believed that their participation in Computing Partnerships programming impacted their computing and technological competence and practices. This included reflecting on how their professional practice changed over the course of the year. Reflecting the survey data, educators addressed the ways in which they sought to improve their professional practice—specifically in the areas of computing and technological practices. Educators did not provide interview or open-ended survey responses about promoting diversity through inclusive practices.

Educators described a variety of professional learning experiences that improved their professional practices, particularly with computing and technology. This professional learning included out-of-school professional learning (e.g., classes they took over the summer or outside of the traditional workday), work-based learning (e.g., learning through apprenticeships, internships), and collaboration/mentorship (e.g., learning together and/or from someone perceived to have more skills in that area of learning). Educators also expressed a belief that additional professional learning would continue to increase their skills. A common theme was that professional learning was the precursor to classroom practice; professional learning gave educators the knowledge and experiences that they needed to engage with computing and technology in their instructional practice.

Educators often described their computing and technological competencies as in-progress. Interviewees believed that they improved over the year but still had more to learn. Moreover, educators often described the importance of collaboration with other educators as important to their ability to gain new competencies. Quotations in Table 4 have been organized into the two most-discussed competency area categories, Seeking Ways to Improve Professional Practice and Computing/Technical Competence and Practice. There is notable overlap between the categories. The dotted lines in the table represent the intersections between how educators worked to improve their professional practice and how developing computing and technological practices was at the heart of many of those professional learning experiences.

Table 4. Educators' Experiences with Seeking Ways to Improve Professional Practice and Computing/Technological Competence and Practice

Competencies	Example quotations
Seeking Ways to Improve Professional Practice	*I liked it when we took a summer week to learn to use CODE. I could use a refresher, and would like to extend that training. (Educator survey)* *I took a class on the Makey Makey . Then throughout the year we were given other opportunities to come into the Maker Space and tryout anything that we hadn't had a chance to try out before. (Educator interview)* *Professional learning for teachers and staff has helped me to understand how to use certain applications in the computing space so that I could use them in class and help students in their use of these applications. (Educator survey)* *[During] work-based learning, I learned different learning platforms from my colleagues. (Educator survey)* *As a teacher supporting these students- the training is so beneficial and needed to be able to confidently teach, guide, and support them. (Educator survey)*
Computing/Technological Competence and Practices	*Professional learning for teachers and staff was most impactful because it provided training to teachers and staff and instilled confidence in using the [new STEM-related] equipment. (Educator survey)* *I think it takes a lot of time [to gain new competencies] and if you're starting at base zero…the first level of everything, you're working slowly through learning things and getting tips and tricks along the way. Somebody who has tried it, who is not starting at zero, can give you a lift and boost you up. (Educator interview)* *I was working as a group to be trained on using our STEM resources. From there we were introduced to the computing standards and then asked to write and try lessons that will have students begin to use these concepts. (Educator survey)* *Professional learning for teachers and staff…allowed me to learn how to use different technology tools and collaborate with other STEM teachers so I could incorporate [new technologies] into our curriculum. (Educator survey)*

Skills related to collaborations with community partners were an area of strength for educators

As part of the UEPC Educator Computing Survey, respondents were asked to assess their skills related to particular grant activities. The Computing Partnerships Grant Program focused on seven key grant activities:

- Innovation and Makerspaces
- Out-of-Classroom Experiences
- Integration of Out-of-Classroom Experiences with Classroom Instruction
- Near-Peer Mentorship
- Work-Based Experiences
- Professional Learning (for Educators)
- Collaborations with Community Partners

Each grant program engaged in three to six of these seven activities (Table 5). Survey participants were asked to rate their competency in activities specific to the project they were involved with. For example, educators from CUES were only prompted to answer items about Innovation and Makerspaces, Professional Learning, and Collaborations.

While educators rated their own competencies for five of these seven grant activities—Innovation & Makerspaces, Out-of-Classroom Experiences, Integration of Out-of-Classroom Experiences with Classroom Instruction, Professional Learning, and Collaborations with Community Partners—the remaining two activities, Near-Peer Mentorship and Work-Based Experiences, were assessed from the perspective students. Due to the nature of these activities, educators were asked to reflect their students' competencies rather than their own. While items related to Near-Peer Mentorship and Work-Based Experiences focus on students' experiences, we include them here to allow the reader to look across grant activities more easily.

Figure 1 provides a summary of educators' own competencies across five of seven grant activities, and Figure 2 contains educators' perceptions of students' competencies across the remaining two grant activities. The light blue bars illustrate the distribution of responses, ranging from "not at all competent" (1) to "completely competent" (5). The dark blue line indicated the mean response within each grant activity. For example, educators participating in Innovation and Makerspaces most commonly indicated that they were "quite competent," and the average response in this bank of items was 3.6, falling between "somewhat competent" (3) and "quite competent" (4).

Looking across grant activities, the greatest level of competency was in the area of *Collaborations*, with a mean response of 4.0. This suggests that educators felt confident in their abilities to collaborate with community partners around computing activities. In contrast, Near-Peer Mentorship was associated with the lowest levels of self-reported competency. The average response in this area was 3.3, or just above "somewhat competent." As noted above, we remind the reader that educators responding to items about Near-Peer Mentorship were asked to rate students' competencies rather than their own due to the nature of the grant activity. Despite this variation, educators generally reported strong levels of competency across grant activities, with all activities falling somewhere between "somewhat competent" and "quite competent" on average.

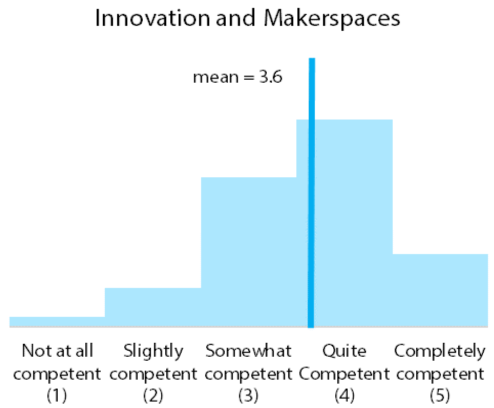
Table 5. Grant Activities by LEA and Project

District	Project	Innovation and makerspaces	Out-of-classroom experiences	Integration of out-of-classroom experiences and classroom instruction	Near-peer mentorship	Work-based learning experiences	Professional learning for teachers and staff	Post-secondary, industry, and community collaborations
CUES	The Portable Universe of Computing, Computing Science, STEM and Coding	X					X	X✓
Duchesne District	Computer Science Experience for Underserved Students in Duchesne County Elementary Schools		X✓	X✓			X✓	
Entheos Academy/ Pacific Heritage Academy	Computing Expeditions Consortium	X✓	X✓	X	X✓			X✓
Granite District (Kearns)	Coding in Kearns	X	X✓			✓	X	X✓
Iron District	Code2Create Partnership Grant	X✓	X✓	X✓		✓	X	✓
Jordan District	Building a Computing Culture	X✓		X	✓		✓	X
Juab District	Expanding Computational Thinking in Juab SD			X			X✓	
Kane District	Expanding a Computer Science Pathway for Students in Kane County School District	X✓	X✓	X		X		
Murray District	Murray PowerPlay	X	X✓			X✓		✓
Pinnacle Canyon Academy	Pinnacle Designs	X	X✓	X✓		X✓		✓
San Juan District	Code to Success, Elementary Coding, Computer Science Professional Development for Teachers, and Mobile Makerspace	X	X				X	

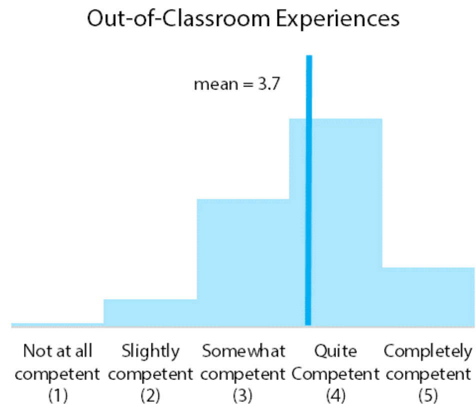
District	Project	Innovation and makerspaces	Out-of-classroom experiences	Integration of out-of-classroom experiences and classroom instruction	Near-peer mentorship	Work-based learning experiences	Professional learning for teachers and staff	Post-secondary, industry, and community collaborations
SEDC	Work-Based Learning Internships and Certifications in 6 Rural Utah Districts					X✓		
South Sanpete District	COVE 21 (Maker Space/STEM Room)	X					X	X
Washington District	Hurricane Cone Site Pipeline for Computer Science		X✓			X	X	X
Washington District (Hildale)	Establishing a Computer Science Pathway for Underserved Students in Hildale, Utah		X✓		✓		X	
Weber District	CS Outreach and Retention Plan		X✓	✓			X	✓
Weilenmann School of Learning	Project-Based Learning Makerspaces	X✓	✓	✓	✓		X	X

Note: ✓ = noted by grantees, X = noted by STEM Action Center

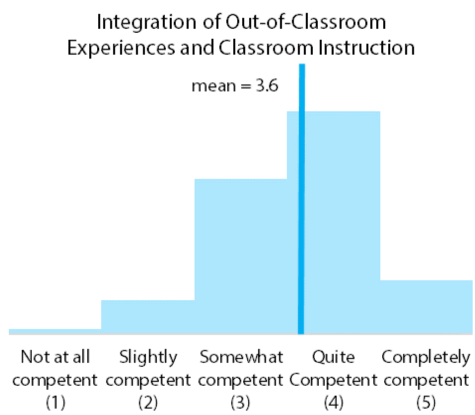
Figure 1. Educators' Competencies Specific to Grant Activities



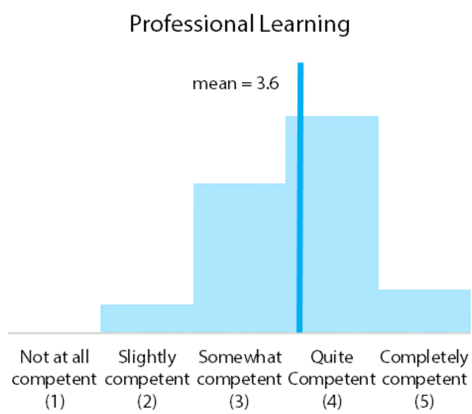
Sample survey item: Design questions to scaffold students in the making process



Sample survey item: Use appropriate techniques and equipment.

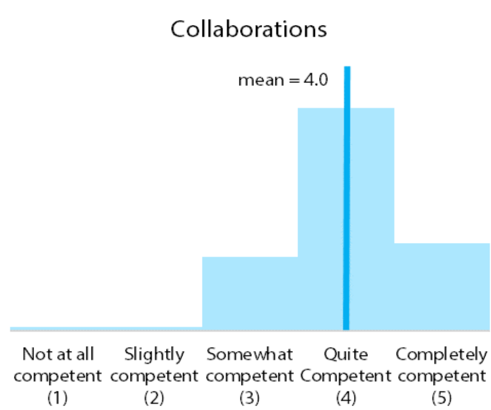


Sample survey item: Align curriculum and activities between out-of-classroom and in-classroom experiences



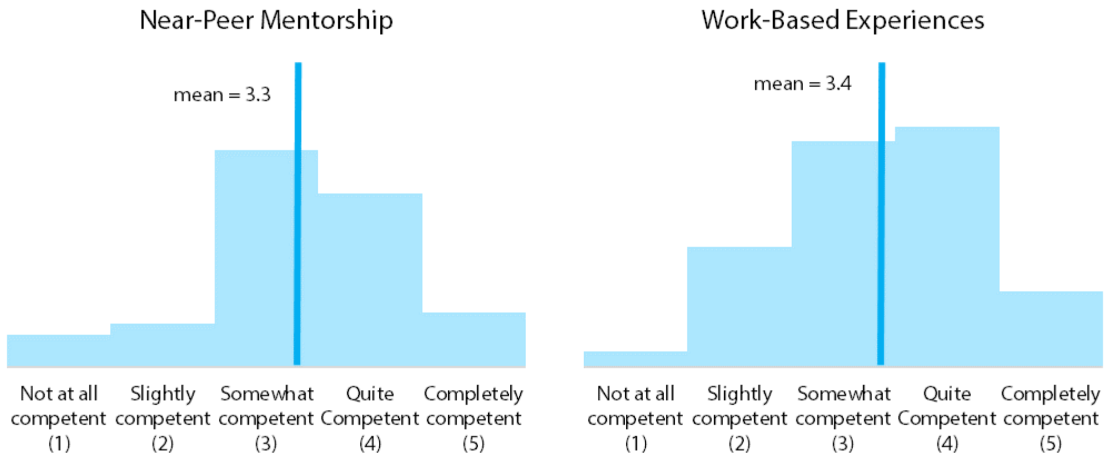
Sample survey item: Integrate computing and computational thinking into other subjects

Note: Educators were only invited to respond to items pertaining to grant activities that their programs were involved with, as noted in Table 5. As such, data represented in Figures 1 and 2 represent subsets of the full group of survey participants.



Sample survey item: Identify who to contact if I have questions about our shared work to support student success in computing

Figure 2. Students' Competencies Specific to Grant Activities



Sample survey item: Demonstrate leadership skills through their work with younger students

Sample survey item: Apply computing skills in the workplace

Educators reported positive beliefs about the value of computing/technology integration

As part of the UEPC Educator Computing Survey, respondents were asked to rate their level of agreement with statements measuring beliefs about the value of computing/technological integration, confidence with their computing/technological skills, and professional satisfaction. As shown in Table 6, educators responded to five to nine items in each area. Within each outcome area, we calculated the percentage of responses that were either "agree" or "strongly agree" on a five-point scale ranging from "strongly disagree" to "strongly agree."

Approximately seven in ten responses (71%) were in agreement with statements about their confidence with their computing/technological skills and professional satisfaction. The perceived value of computing/technology integration was greater. In this domain, 85% of responses were either "agree" or "strongly agree."

Table 6. UEPC Educator Computing Survey Outcomes

Outcome Area	Number of Survey Items	Sample Items	Percentage in Agreement
Perceived Value of Computing/Technology Integration	9	• *Properly designed learning activities that integrate technology can promote students' active participation.* • *Students learn more easily when using technology.* • *Instruction is more effective with technology.*	85%
Confidence with Computing/Technological Skills	6	• *I know how to get students excited about computing.*	71%

		• *I usually welcome students' questions about computing concepts.* • *I am willing to be observed by a teacher leader while teaching computing concepts.*	
Professional Satisfaction	5	• *My present conditions as an educator are excellent.* • *I am satisfied with being an educator.* • *If I could choose my career over, I would change almost nothing.*	71%

Open-ended survey responses and interview data augment educators' higher rates of agreement with survey items measuring the value of computing/technology integration and lower rates of agreement with survey items measuring confidence with computing/technological skills and professional satisfaction. Summarized in Table 7, examples of these responses suggest that educators and/or their colleagues may have rated their confidence with computing/technological skills in part due to comparing their technology skills to students perceived to have more advanced computing skills than they did at times. Educators also described enjoying their peers' support as they collaborated and planned. The following quotations provide more insight into participants' experiences:

Table 7. Examples of educators' experiences related to valuing of computing/technological integration, confidence with computing and technological skills, and professional satisfaction

Outcome Areas	Example Comments
Perceived Value of Computing/Technology Integration	*Integration of technology into the science classroom instruction has helped me provide better instruction for students. (Educator survey)* *I think one of the most valuable things is having that access to the technology and having different ways of being able to get the kids to do similar tasks. So, "Can we build something on the 3-D printer? Can we build it conceptually? Can we print it? Can we also do the same thing out of a LEGO?" And to be able to use those different disciplines with the kids has really helped. And to be able to use the things that we have from this grant to build excitement. (Educator interview)* *The biggest challenge was teaching 26 classes and having the equipment work the same each time a new classroom of students would use it. If there are resources available to replace equipment or provide software upgrades or enhancements to have full performance and capabilities so each student will have the full opportunity and experience available to them every time. (Educator survey)*
Computing and Technological Skills Confidence	*Our after school program has given me confidence to integrate computer coding in my classroom, and has helped me to develop relationships with students in other grades. (Educator survey)* *Our staff trainer has been great; however, I would love to have more hands-on training to build my confidence on using the space. (Educator survey)*

	I would like more training on the coding end of it…to be able to be more confident in that basic coding for students who probably can code better and faster than us, that would be really helpful to me to have more of a working knowledge, so I'm not just staying one step ahead of six-year-olds. (Educator interview)
Professional Satisfaction	*The continued professional development and being able to work together with the other schools in our district have been a great asset. I would like to see that continue. (Educator survey)* *We have had a lot of fun learning how to use robots and all of the things that they can do. (Educator survey)* *We have two first-grade teachers this year, and we each teamed up with a third-grade teacher to help us... So it's been really fun having that near-peer interaction with the kids, especially as the year went on and [student near-peers] could spend more time together. So [our first and third grade teaching team] had collaboration with each other in our planning, and then that collaboration with our [student-to-student] near-peers. So that was fun. And then to have the perspective of an older-grade-level teacher going, "Here's what we've done and how we've done it," has really been successful also. (Educator interview)*

Educators named learning opportunities and collaboration as supports, while challenges pertained to the availability of developmentally appropriate materials, time, and COVID-19

What factors support and impede educators' computing competence (particularly with aligning curricula with CS standards), confidence, job attitudes/satisfaction, and value of computing?

Drawing on open-ended survey data from the UEPC Educator Computing Survey and educator interviews, as well as the UEPC Grantee Survey, we sought to understand the factors that supported and impeded educators in integrating technology and computing into the curriculum. Overall, we found that training opportunities and collaboration with other educators were primary sources of support. The factors that impeded educators' competence, confidence, and value of computing in the 2020-21 school year centered around the limited availability of developmentally appropriate activities, lack of time, and challenges related to the COVID-19 pandemic. The following sections provide more detail about each of these factors and examples of supporting data from educators and grantees.

Supporting Factors

Support, Training, and Learning Opportunities
Support, training, and learning opportunities were described collectively as an important factor in educators' ability to integrate technology and computing into the curriculum. Specifically, they discussed the value of understanding the available materials, learning how to use them in the classroom, and receiving ongoing support through training sessions and guidance from leadership. While most comments about available training and learning opportunities were positive, to capture the range of responses, we note that a few participants expressed negative feedback (e.g., "The training was long, boring, and not very effective…[it] was echoed throughout my school as a horrible waste of time…").

- *Before implementing the technology it is vital that I understand what materials are available and have a few ideas of how they can be used. (Educator survey)*
- *Because I was new to STEM having additional support and training made all the difference for me being able to take this into the classroom. (Educator survey)*
- *Having the monthly trainings and ongoing support from [a district leader] was very helpful. (Educator survey)*
- *As a teacher supporting these students- the training is so beneficial and needed to be able to confidently teach, guide, and support them. (Educator survey)*
- *Additional training and support from the grant managers would be very helpful - especially if they can provide specialists or experts from the community to support our work. (Educator survey)*
- *Continue to provide efficient ways to teach Computer Science, training, and support. (Educator survey)*
- *It would be really helpful if there was a list of good trainings to attend or a way to find out what training are being offered. Often times a training are announced a few days in advance without time to make it. (Educator survey)*

Collaboration with Other Educators
Collaboration was highly valued by educators and supported the development of individual competence. Although some educators noted that the pandemic was an added challenge for educator-to-educator collaboration, they also described how collaborative support added to their ability to gain knowledge and experience. Participants discussed how some of the factors that initially impeded them at the beginning of the project became less challenging as their own comfort and skill levels increased over the course of the year.

- *Honestly, I would not have been able to learn as much, I would not have been to do as much with my students if I did not have that collaborative support [from my teaching team]. (Educator interview)*
- *I learned different learning platforms from my colleagues. (Educator survey)*

- *Having somebody to work with who asked different questions, having somebody to work with who started from a different spot and who understood more [than me] really did pave the way for me to be more successful and provide different opportunities for my students. (Educator interview)*

- *For me, near-peer mentorship ended up being the most impactful aspect for my first year of teaching. It was a great balance of being mentored and closely guided while also being given independence in planning and solidifying our project-based learning activities. (Educator survey)*

Impeding Factors

Availability of Developmentally Appropriate Activities and Resources
In response to an open-ended question about the challenges they faced during the grant program, some educators shared that program curricula, activities, and resources were not developmentally appropriate or relevant for the students they taught. Several respondents specifically attributed this challenge to their students' age/grade level, while others spoke more generally about issues related to amount and pacing of content in relation to their students' abilities.

- *Finding curriculum that was age level appropriate for my 1st grade class [was a challenge]. They loved every single lesson, but a lot of the lessons were so jam packed that it went over their heads. (Educator survey)*

- *Most often, the activities were not developmentally appropriate for young children. (Educator survey)*

- *Material has been too challenging and complicated for the students I am in charge of. Too much was expected of them in a single day, it would have been better if they had received instructions one time and completed the task the next week. (Educator survey)*

- *It was not geared to Pre-K, so many of these items do not apply to my students. We did not even touch computers in the school this year. (Educator survey)*

Time
Another challenge that educators frequently named was lack of time as a barrier to their successful implementation of program activities. Respondents discussed the difficulties of balancing grant requirements with their teaching responsibilities, and shared feeling that they needed more time to effectively utilize resources like computers and makerspace tools.

- *Finding time to meet grant requirements in addition to my regular teaching responsibilities [was a challenge]. There just isn't enough time in a teacher's day to do all that's expected. (Educator survey)*

- *I would say the biggest challenge was how short each grade level's window was to use the maker space. I don't feel like 4 total days for a class was enough time. (Educator survey)*

- *[We need] more time to have students use computers in an investigative way. (Educator survey)*

- *Finding the time and energy to follow the requirements of the grant in the midst of all the other challenges of teaching students in a hybrid world of in-person and virtual learning. It's just a time-*

consuming and labor-intensive work that decreases time and bandwidth for other aspects of the classroom. (Educator survey)

COVID-19

The COVID-19 pandemic was also cited as a factor that impeded educators' competence and ability to integrate technology through grant activities. Examples provided by educators reflected the effects of the switch to virtual teaching and learning, specifically noting the ways in which quarantining and social distancing impacted their ability to use resources and implement hands-on, collaborative activities.

- *COVID-19 has been an obstacle to our program. It has made it difficult for many of our students to meet the attendance goals for our grant due to mandatory quarantining. Our COVID guidelines also made it difficult to work together as well as we have been able to do in past years. (Educator survey)*

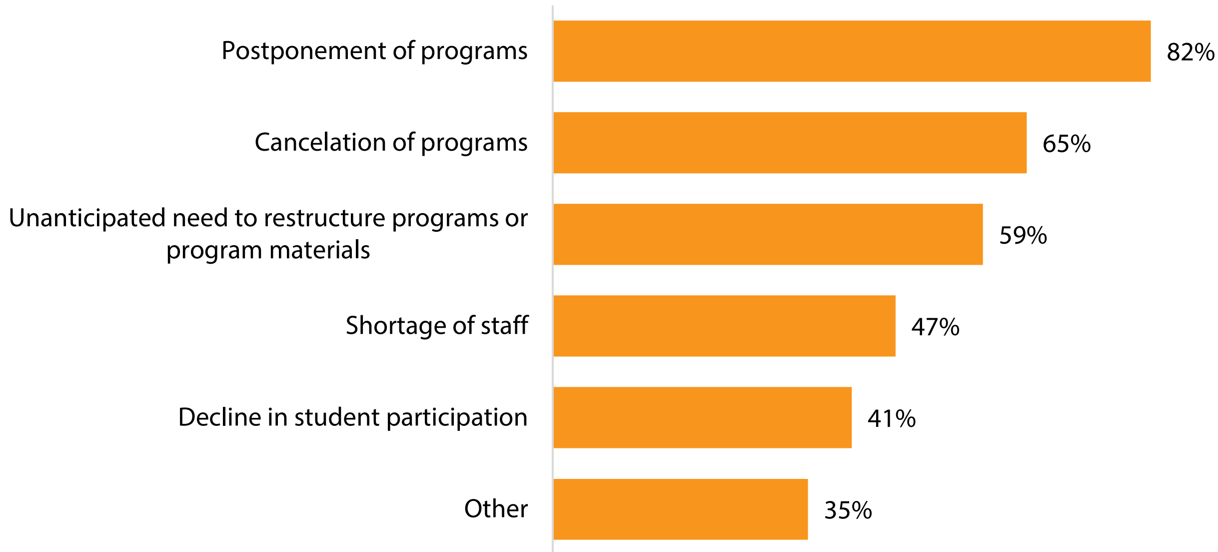
- *The biggest challenge has been utilizing all of the resources during a pandemic. For a while we weren't able to have our students come into STEM since it was an outside of school activity. I look forward to a return to normal next year. (Educator survey)*

- *This has been a strange year for implementing a hands-on learning lab such as a maker space- with many unknowns early in the year [about] how equipment can be used and shared in a COVID-friendly manner…I have also struggled in [thinking about] how to provide similar experiences to students who were participating in remote learning. (Educator survey)*

- *The biggest challenge has been all of the COVID protocols. Because so much what we did in this program was hands on and working together we had to adjust a little. Lucky for my school I had great support to make sure it was still successful. (Educator survey)*

Several of the unexpected COVID-related barriers that educators discussed—such as inconsistent student participation and significant changes to program activities—aligned with grantees' perceptions of program implementation in the 2020-21 school year. As part of the UEPC Grantee Survey, grantees were asked to describe progress (or lack of progress) made and challenges experienced with grant activities. As illustrated in Figure 3, the most common challenge indicated by grantees was postponement of programs (82%), followed by program cancelation (65%) and unanticipated need to restructure (59%). Several individuals provided write-in "other" responses, noting issues such as scheduling, social distancing, and sick students.

Figure 3. Challenges to Implementing Grant Activities (Spring UEPC Grantee Survey Responses)



Participants described problem-solving and adapting to address COVID-related challenges, including shifts to virtual formats and navigating issues related to space and social distancing

How did educators provide continuity for programming during the COVID-19 pandemic?

Informed by interview and open-ended survey data from grantees, partners, and educators, we evaluated the extent to which educators were able to provide continuity for programming during the COVID-19 pandemic. The COVID-19 pandemic affected at least one aspect of every project. The nature of these impacts varied across projects. For example, some project activities were postponed, or the work continued behind the scenes. Although the COVID-19 pandemic brought on a range of unexpected challenges, many grantees, educators, and partners described efforts to engage in problem solving so that program implementation could continue, albeit often in a restructured or adapted manner. Common adaptations included limiting the number of student participants at any given time and/or reducing the number of student participants who could utilize the materials at the same time due to social distance requirements (e.g., taking half the class into the Makerspace classroom rather than the entire class.). Some grantees described efforts to maintain community partnerships and engage in strategic planning to support current and future program implementation.

The following quotations provide examples of some of the solutions to pandemic-related challenges:

> "Our students had some quarantine periods, but we blazed on."
>
> (Educator survey)

- *Masks and limited groups were an improvement from closed school status, but this limited our enrollment to 28 students. (Educator survey)*
- *Southern Utah Girls in Technology (SUGIT) activities included a one-day hands-on STEM workshop for high school girls from Utah. Due to COVID-19, the SUGIT 2020 and 2021 in summer was hosted virtually on Google Classroom. Due to the success of virtual SUGIT, the 2022 SUGIT's activities will include: One day campus conference (if the COVID-19 circumstances permit); a two- week virtual platform with technology workshops, videos, certificates, and networking opportunities; and post event(s) of SUGIT for educators and students. (Partner interview)*
- *There were a lot of COVID adaptations. For example, we couldn't bring our entire class into the Maker Space [room]. It's just not big enough to support that type of social distancing. That was something that I don't think we knew in the beginning and so we had to adapt how to get our children to the Maker Space safely… we did have to change our plans in the beginning. I think that we just thought we would bring our whole class to the Maker Space. (Educator interview)*
- *Largely inspired by the environment created by the pandemic, this last year, we've created a lot of virtual and mobile learning platforms so, we now have a simulator that we can bring into*

classrooms. So, we will come with consoles and a portable capsule, and we can convert any classroom into a space station simulator, and we can do that anywhere in the state. (Partner interview)

- *Even though Covid created some challenges, we were able to continue to work with our community partners. We are excited to continue to work with them and work towards adding additional partners in the future. (Spring Grantee Survey)*

- *The capacity of leadership at the junior high and elementary schools was limited due to the pressures of a unique school year. However, a leadership team was created and staging was completed to map out what activities could take place in the makerspaces and materials and supplies were purchased. The plan is now to identify which elementary schools and junior high will have the capacity to take the lead. For the opportunities for elementary students to have access to computer science standards, everything is set into motion for this to happen beginning in the 2021-22 school year. Materials and programs have been purchased and personnel has been hired and will be trained during June 2021! We are well on our way! (Spring Grantee Survey)*

Students' Experiences and Outcomes

In *Students' Experiences and Outcomes,* we evaluate the Computing Partnerships Grant Program's impact on student outcomes. To do so, we focus on a single evaluation question to identify the impact the program had on measures such as student self-efficacy/confidence, interest, engagement, computational thinking, and computing identity. To answer this evaluation question, we draw upon interviews and educator survey data. In this section, we also briefly describe our pilot student survey findings. Findings in this section are organized by theme. Overall, we found that the Computing Partnerships Grant Program was associated with numerous positive student outcomes such as computing interest and computing identity.

How effective are Computing Partnerships Grant activities at increasing students' computing self-efficacy, interest, engagement, skills (as aligned with Utah's CS standards), computational thinking, awareness of computing career opportunities, and intentions to pursue computing?

A majority of educators agreed that participation in Computing Partnership activities resulted in positive student outcomes

Educators of PK-5 students who participated in the UEPC Educator Computing Survey (n=84) were asked to assess their students' outcomes in the areas of self-efficacy/confidence, interest, engagement, computational thinking, and computing identity. Table 8 provides a summary of these measures, including subconstructs for computational thinking and computing identity. The number of survey items used to measure each construct ranged from two to 11 items. Rather than reporting each individual item, we generated a composite measure for each outcome area to understand student outcomes more broadly.

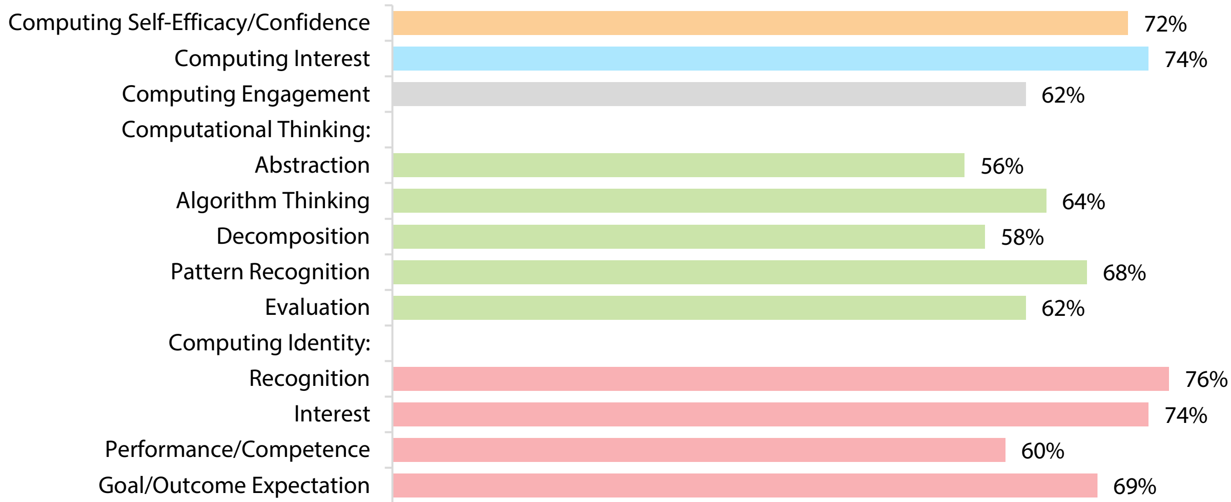
Within each outcome area, we calculated the average response on a five-point scale, where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. Most educators agreed with or were neutral about the statements in each of these domains. For example, the average response to items measuring computing self-efficacy/confidence was 3.8, indicating responses just below "agree" on a five-point scale. Average responses ranged from 3.5 to 3.9, with abstraction and performance and competence on the lower end and computing interest on the higher end.

Table 8. Educators' Perceptions of PK-5 Students' Computing Outcomes

Outcome Area	Number of Survey Items	Sample Item	Average Response (1-5 Scale)
Computing Self-Efficacy/Confidence	9	*My students do not feel nervous learning about computing topics.*	3.8
Computing Interest	11	*My students find materials on computing topics fascinating.*	3.9
Computing Engagement	12	*My students listen actively during instruction about computing topics.*	3.6
Computational Thinking		*My students usually…*	
Abstraction	3	*...think about the relations between different problems.*	3.5
Algorithmic Thinking	3	*...try to lay out the steps of a solution.*	3.6
Decomposition	3	*...think about if it is possible to break apart a problem.*	3.5
Pattern Recognition	3	*...think about how to apply a solution to other problems.*	3.7
Evaluation	3	*...try to find the most effective solution for a problem.*	3.7
Computing Identity		*My students…*	
Recognition	4	*…think of themselves as computer-savvy*	3.9
Interest	3	*…are curious about computing topics.*	3.8
Performance and Competence	3	*…help others with software.*	3.5
Goal/Outcome Expectation	2	*…plan to work in a computing job in the future.*	3.7

To provide additional nuance, the values presented in Figure 4 represent educators' perceptions of student outcomes in a slightly different format than Table 8. The values in this figure represent the proportion of responses that were either "agree" or "strongly agree" within each student outcome measure rather than composite measures on a five-point scale. Rates of agreement ranged from 56% to 76%. The subconstructs within computational thinking (abstraction, algorithmic thinking, decomposition, pattern recognition, and evaluation) had relatively low levels of agreement when compared to other outcomes such as computing interest and computing identity.

Figure 4. Rates of Agreement with Educator Survey Items Measuring Student Outcomes



In interviews and open-ended survey data from the UEPC Educator Computing Survey, educators further described how students engaged with the materials and resources provided by the Computing Partnerships Grant Program. Educators noted that most students demonstrated high interest and engagement with Computing Partnership-related materials and resources and often provided examples of how students enjoyed new approaches to learning, such as creating Ozobots or using 3D printers. According to educators, students' interest and engagement in these types of learning activities led to increased skills with the new technology. Interviewees associated computational thinking with the tasks they had created (e.g., cause and effect when writing a program involving a moving object and designing and finding solutions to problems). Although not all educators observed high levels of engagement in their students (e.g., one educator survey response was "Appropriate student use of technology and computing tools was a concern this year. Technology provided as much of a distraction as it was a teaching tool this year"), many educators reported high levels of student engagement and interest. The following sample of quotations are examples of how educators perceived students' experiences:

- *[The students] can use coding, like with the Ozobots. They see [the Ozobot] has to go this way and then that way to make the connections. They're actually seeing [cause and effect] through the technology, where they'd maybe have struggled seeing it on a two-dimensional paper before. (Educator interview)*

- *Innovation and makerspaces were impactful because students were able to engage in authentic learning, design thinking, and project-based learning in the marker spaces. (Educator survey)*

- *We paired [first-grade students] this year with a third-grade buddy to develop their own 3D printing thing. So they had to use that technology with a third-grade buddy… just they loved it. They were so motivated by it and they just caught on so quickly that they were able to design... they just caught on so quickly to utilizing that technology. (Educator interview)*

- *Students were engaged and motivated to create and integrate [Innovation and Makerspaces] in their daily lives. They were able to explore, design and find solutions to problems. (Educator survey)*

- *I had a few students participate in the Code Ninjas after school program at my school. They all expressed high engagement and interest in the program, and learned new coding skills that they were excited to use. (Educator survey)*

Educators most frequently identified Out-of-Classroom Experiences and Innovation & Makerspaces activities as meaningful for students

Within the UEPC Educator Computing Survey, respondents were asked in an open-ended survey item to identify the one grant activity that was most meaningful for students and to provide an explanation. The educators who responded to this question most often named Out-of-Classroom Experiences (approximately 50% of respondents) and Innovation and Makerspaces (approximately 30% of respondents). It is important to note that these two activities were more common across projects than other activity types (see Table 5), which may have influenced the frequency with which they were identified as meaningful. Given this frequency, our analysis of educators' explanations yielded salient themes for these two activities more so than for other activity types. Below we provide a summary of themes and examples from educators' explanations of the meaningful aspects of Out-of-Classroom Experiences and Innovation & Makerspaces.

Out-of-Classroom Experiences

Educators who identified Out-of-Classroom Experiences as most meaningful for their students explained that these activities provided opportunities for student choice (as opposed to required classes), real-world experiences, collaboration with peers in different environments, and confidence-building.

- *The after-school program and clubs impact the students the most because it is often what they are choosing to do instead of required to do. Therefore, they enjoy it more and in turn is more meaningful. (Educator survey)*

- *These kiddos are able to learn and grow in confidence and thinking. Problem solving, collaboration are all natural aspects of working with robotics and these are all skills needed in the real world. (Educator survey)*

- *…the competitions provided students something to work towards and an experience to work with students of other schools in learning to build and code robotics. (Educator survey)*

- *Students are able to interact in multiple environments. (Educator survey)*

- *I think the most impactful thing for our students this year has been the before and after school experiences. Having the chance to come into the school and collaborate and solve problems served as valuable in increased competency with the various programs and also improved confidence among the participants. (Educator survey)*

Innovation & Makerspaces

Educators who identified Innovation & Makerspaces as most meaningful for their students noted that these activities facilitated student engagement, creativity and design, and hands-on learning and tool use.

- *Innovation and makerspaces has some amazing tools for the children to use. They have many options to work with and it leads to great creativity. There is so much to get out of this room and the resources can be used in a variety of ways to cover many topics. (Educator survey)*

- *The makerspace allows my students the freedom to create, construct, and design. It has boosted their critical thinking skills and creativity. (Educator survey)*

- *Allowing students to have a space of free creative and discovery is where they learn the best. I also find when students have the chance to learn from other students or teach students they are the most engaged. (Educator survey)*

- *Students had the opportunity to explore, and create, having hands-on opportunities to work as a team to develop and see in real life theory to practicability. (Educator survey)*

LEA Implementation and Adaptations

In *LEA Implementation and Adaptations,* we evaluate the role of LEAs in the implementation and outcomes of the Computing Partnerships Grant Program using interview and survey data, including data from the UEPC Educator Computing Survey and the UEPC Grantee Survey. We address two evaluation questions pertaining to the implementation and adaptation of program elements by LEAs and the degree to which LEAs have met their goals and objectives. Overall, we found that educators had mixed perceptions of program implementation as programming was adapted to fit each unique context. While progress was made on grant objectives, many have not yet been completed.

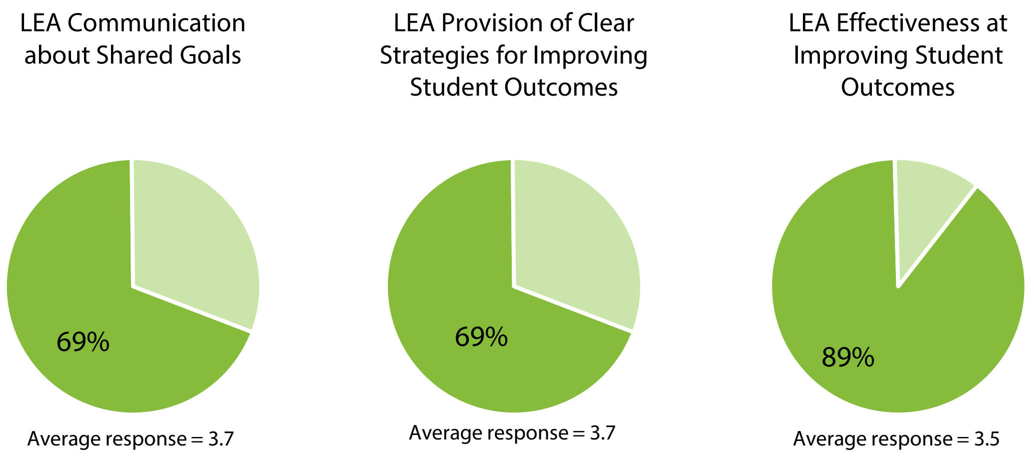
Program implementation reflected individual program objectives and varied across project sites

How well were the program elements of the Computing Partnerships Grant implemented and adapted at each LEA to support students' computing self-efficacy, interest, engagement, skills (as aligned with Utah's CS standards), computational thinking, awareness of computing career opportunities, and intentions to pursue computing?

The implementation of Computing Partnerships projects occurred in a variety of ways based on each unique project and context. The variations across projects – the range of LEAs, different objectives of each project, the unique partnerships, which educators and students were involved, during school versus out of school times – created a wide range of different program implementation approaches.

To understand implementation across projects, educators were asked to rate their LEAs' program implementation in three areas – communication about shared goals, provision of strategies to improve student outcomes, and effectiveness in improving student outcomes. Within each of these three areas, educators responded to several survey items. By asking multiple items in each of these three areas, we were able to generate composite measures, allowing us to generate a more complete picture of educators' perceptions of program implementation within their LEAs. As shown in Figure 5, educators reported relatively positive perceptions of LEA program implementation. Percentages noted in the figure indicate the proportion of "agree" or "strongly agree" responses to items related to the three topics. Values below each pie chart indicate the average response on a five-point scale, where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. On average, responses fell somewhere between "neither agree nor disagree" (3) and "agree" (4) about LEA Communication and Shared Goals, LEA Provision of Clear Strategies of Improving Student Outcomes, and LEA Effectiveness at Improving Student Outcomes. While agreement that LEAs were effective at improving student outcomes was relatively high (89%), only 69% of respondents agreed with items about LEAs' communication about shared goals and provision of clear strategies for improving student outcomes. Substantial variation in responses was identified across LEAs, with levels of agreement ranging from 0% to 100%.

Figure 5. Educators' Perceptions of LEA Program Implementation



Note: Darker shades of green represent the percentage of responses that were either "agree" or "strongly agree."

Interview data suggest that support from school administration had a positive effect on educators' perceptions of LEA program implementation. The following interviewee quotations show how involvement from administrators impacted the implementation of two projects:

- *One principal was just above and beyond. [The principal] would come in and tour the room, have kids show her stuff, ask questions. She was in helping them do all their log-ins at the beginning, so I feel like she really understood what the kids were working towards, and so it was just extra easy to work at that school. (Partner Interview)*

- *The excitement from the administration contributed to our success.. They encouraged us to break away from where we would normally have been doing things. And this year it's been hard to sit here and go, "Well, we're already breaking away from so many things. We're already doing so much, and now you're giving us another thing to do?" And they were super supportive and encouraging [by saying things like], "This isn't another thing to do. This is how can you use this to be something great, in something that you're already doing." That was a really big part of it. (Educator interview)*

Although substantial progress was made, many objectives have not yet been completed

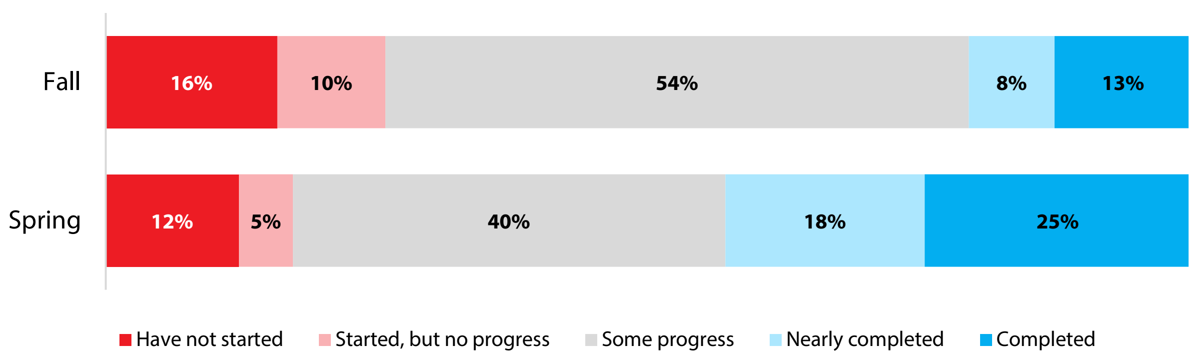
> *To what degree has each LEA met its goals and objectives for the Computing Partnerships Grant?*

Full results pertaining to LEAs' progress on grant goals and objectives are available on the electronic data dashboard that has been made available to STEM Action Center personnel and grantees. Here we provide a high-level summary of the progress made on grant objectives in the fall and spring of the 2020-21 school year.

As depicted in Figure 6, grantees reported substantial progress on grant objectives between fall and spring of the 2021-21 school year. It is important to note that many of the schools and LEAs engaged in the Computing Partnerships Grant Program were also impacted by shifts in schedules and format due to the COVID-19 pandemic. While only 21% of grant objectives were either "nearly completed" or "completed" earlier in the school year, 43% reached this same status at the end of the school year. Similarly, the percentage of objectives that had either not been started or had achieved no progress decreased from 26% to 17%. This demonstrates substantial progress across LEAs as they work toward their program objectives.

At the same time, however, we note that there is still much work to be done. Despite the marked increase in completed or nearly completed objectives, most have not yet been completed. Our evaluation will continue to monitor progress toward these objectives in the 2021-22 school year, including studying changes that may occur with implementation and related outcomes.

Figure 6. Reported Progress on Grant Objectives (Fall and Spring Grantee Surveys)



Interviewees reflected on the extent to which their projects were successful in meeting objectives and goals. To ensure that participants were aware of their projects' objectives when responding to interview questions, the interviewer provided the project-specific objectives and goals and asked the interviewee about the project's overall success and challenges related to that objective. In general, interviewees felt their projects had successfully met most project objectives. The quotations in Table 9 illustrate several examples:

Table 9. Participant Feedback about Progress toward Project Objectives

Project Objective	**Example Quote**
Increase equitable access to computing learning and application in the school and within the school community and goal that each student will have scheduled times with their classrooms or small groups to access traditional and technological maker spaces.	*I wasn't involved in the [objectives and goals] conversations. So what was handed down to me from our leadership is what we did strive to achieve. So from a teaching perspective we were told we have minimum requirement hours in the STEM room. We were able to be creative with that and I worked together with my team so that we could put small groups in the STEM room. So yes, we tried to meet the requirement of the minimum hours in the STEM room and we were very aware of giving [the students] opportunities to use a variety of things in the STEM room. (Educator interview)*
Create maker spaces over the course of the award years that will enable students to learn and apply computational knowledge, critical thinking, and authentic application and goal that Professional Development for educators and staff on standards, skills, concepts related to computer science and maker space tools.	*The success was a lot higher than I had envisioned, because I initially envisioned that the kids would struggle. And so their success helped drive me to go further. Where the computing standards for first grade is to turn on devices and log in... to see that [these first-grade students were] able to turn on a device, log in, get into a program, and navigate a program all the way to making a 3-D print..." {educator goes speechless, shakes her head and raises her hands high in the air} (Educator interview)*
Increase the number of opportunities elementary students K-6 have access to the Computer Science Standards by providing before/after school coding clubs and interns teaching alongside mentors.	*I think [we] did well [in meeting the grant's objectives.] By having this much time at each school, we were there for 15 hours, an hour and a half twice a week for five weeks. The kids were able to learn how to use Scratch really well, and learn a number of coding fundamentals that if they move into an actual coding language that we have to type and have a syntax, they already know how those things work in a visual way. They've had it happen where they've built games from a blank screen. So that access worked really well. And the interns worked well. [At] Murray High School we went and talked with their interns and offered them the opportunity to come [intern in the after-school Code Ninjas project] if they wanted. We had four interns that worked with us every week that just really enjoyed it, the teaching side, and they loved the idea of working at Code Ninjas someday. (Partner interview)*

External Support for Program Implementation

In *External Support for Program Implementation*, we examine the role of two types of external support for the grant program, namely the collaborative community partnerships and the STEM Action Center, in supporting the development and expansion of computing in schools. We address two evaluation questions in this findings section, the first pertaining to the effectiveness of partnerships at supporting goal attainment, and the second pertaining to STEM Action Center's role in building educator and school capacity, practice, and scaling up through the analysis of interview and survey data. Overall, external support of the grant program was strong, but some forms of support were more robust than others.

How effective are post-secondary, industry, and community collaborations at supporting program objective and goal attainment?

In what ways and to what extent has the STEM AC supported the development and expansion of computing in schools—teacher and school capacity, practice, and scaling up?

Partner collaborations were key to program objective and goal attainment

Partnerships with community partners, industry partners, and post-secondary partners played important roles in program objectives and program goal attainment for the projects that elected to engage in external partnerships. Community, industry, and post-secondary education institutions were all represented when looking across all project partners. Of the 17 LEAs who completed the 2021 Spring Grantee Survey (100% response rate), seven projects reported engaging in external partnerships during the 2020-21 school year. Out of those seven projects, six partnered with two or more external organizations. Table 10 summarizes partners by organization type.

Table 10. Computing Partnerships Grant Program External Partners

Community Partners	Industry Partners	Post-Secondary Partners
4H	Cyberjet	Dixie State University
CodeChangers	Facebook	Snow College
Fremont Indian State Park	Future InDesign	Southwest Technical College
PTO	Guardsight Cybersecurity	University of Utah
Utah Afterschool Network	Metalcraft	University of Southern Utah
Washington Libraries	Northrop Grumman	Utah State University
	Skill Struck Computer Science	Utah State University Eastern
		Utah Valley University
		Westminster College

According to interview data, collaboration with partners took many forms. For example, collaborations occurred between an after-school program and a partner, Code Ninjas, to expand after-school opportunities for students; through thought partnership about reaching rural populations; and through outreach from a college professor to high school girls in multiple districts to participate in the Southern Utah Aspirations in Computing competition. The following quotations provide additional details about how different projects engaged partners in the types of collaboration described above:

- *The communication and guidelines were all very clear. So as I entered either the [after-school program] relationship, big picture, or the specific school site, I felt confident that we had all the information we needed to be successful. That was good, because it allowed me to provide a layering of options to see what worked for the district. In terms of the district, they did a great job of making sure we had all the tools we needed before we got in. So all the student emails we could set up, all the log-ins, and coordinating with the schools to make sure we had all the calendar information; and that we were able to tour the site and see our location. (Partner interview)*

- *This last year, we've created a lot of virtual and mobile learning platforms so we now have a simulator that we can bring into classrooms. We come with consoles and a portable capsule, and we can convert any classroom into a space station simulator, and we can do that anywhere in the state. So, some of the stuff that I was talking to [an educator] about was bringing those programs to his students who are in more remote locations. (Partner interview)*

- *Aspirations in Computing is an online competition for 9th-12th grade girls. I provide outreach to girls in rural, remote, limited-exposure areas who might lack confidence and not participate in the competition without encouragement and support…I've built some strong relationships with teachers and I come to class, talk to the girls and recruit from those classrooms…This year by Zoom… There's representation from 15 districts in Utah [in recent Aspiration competitions]. (Partner interview)*

Additionally, partners seemed passionate about their work within the Computing Partnerships, expressing how the work associated with the grant was motivating and meaningful for them personally and professionally. The grant also sparked creative forward-thinking about the future of these projects. In interviews, partners shared ideas for expansion that might strengthen the impact of the project:

- *I manage businesses, but my passion isn't in earning the money…I'm here for the kids, and I'm gonna do what's best for the kids, and I'm not gonna squeak out every dollar [from a contract]… and I love saying, "What could it be like?" instead of "What is it like?" (Partner interview)*

- *My goal is to create a pipeline for high school girls to become women in technology. And I realized there is a lack of awareness about careers in computing and that our educational culture in technology and computing needs to diversify…My [educational grant partner] has allowed me to continue this work via this grant… Next, I would love funding to recruit students and take them to conferences. (Partner interview)*

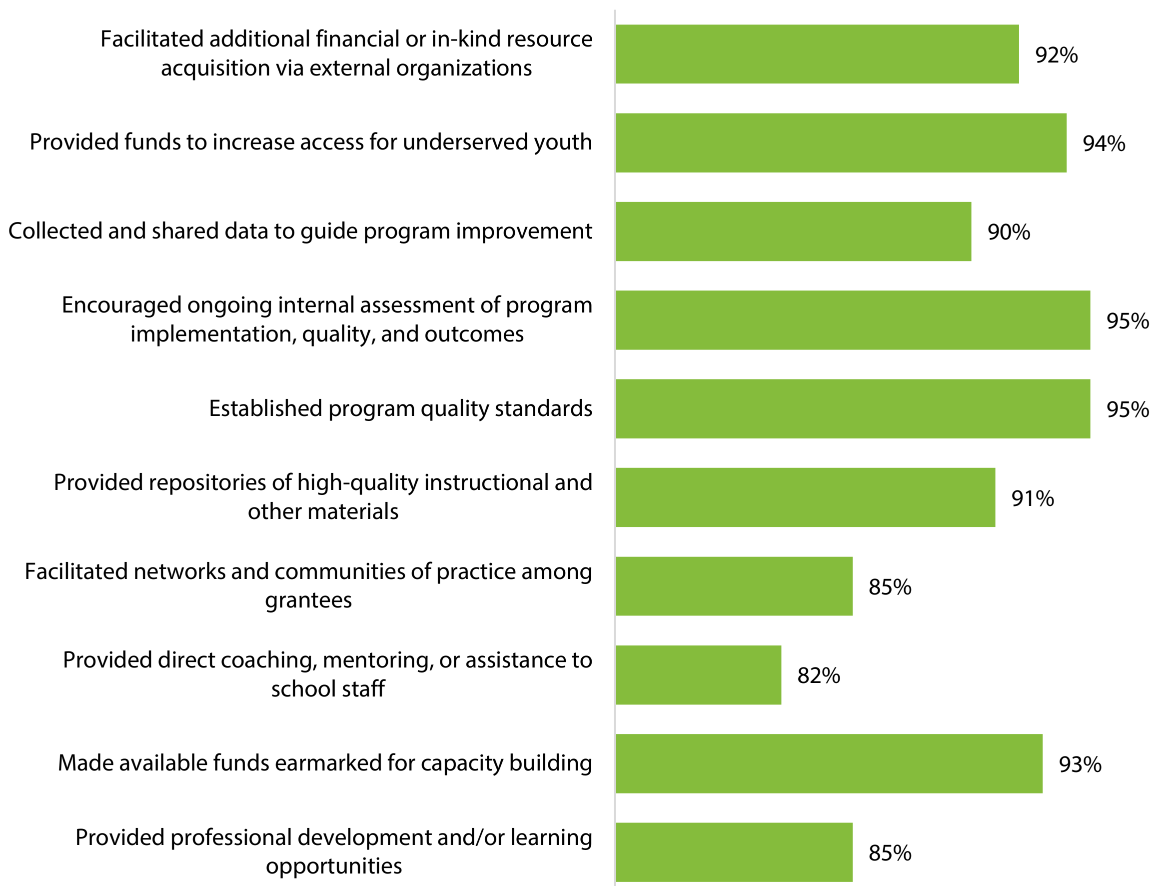
- *I love working with kids and helping kids to understand that being passionate about things is actually a cool thing to do and so we're working…to develop some community partnerships in [rural] area[s] to sponsor a remote camp and be able to promote that in schools. And one of the ways schools [can offer] support is actually by hosting us. So, if we bring a camp to your area, using school's resources for that helps a lot. It helps us keep the costs down. (Partner interview)*

Support from the STEM Action Center, particularly through funding, supported development and future expansion of computing in and out of schools

As part of the UEPC Educator Computing Survey, participants were asked to rate the extent to which the STEM Action Center engaged in a number of activities to build the capacity and practice of school administrators and educators and support the scaling up of computing activities at LEAs. Figure 7 illustrates the proportion of educators who indicated that the STEM Action Center had engaged in various activities "to a large extent" or "to a very large extent" on a five-point scale including "not at all," "to a small extent," "to a moderate extent, "to a large extent," and "to a very large extent."

Educators provided positive feedback about the STEM Action Center across all survey items. The proportion of respondents who selected "to a large extent" or "to a very large extent" ranged from 82% to 95%. Nearly all respondents indicated that the STEM Action Center was helpful in encouraging ongoing internal assessment of programming, establishing program quality standards, and providing funding and resource acquisition. Feedback about direct coaching, mentoring, or assistance to program staff and professional development and/or learning activities was slightly lower, but nevertheless strong (93-95% vs. 82-85%).

Figure 7. Educators' Perceptions of the STEM Action Center



Through interviews and open-ended survey responses, educators and partners expressed appreciation for grant funds that allowed them to engage in new ways of teaching and learning over the past year. They expressed that without grant money, the resources, training, and experiences they had this past year would likely not have happened. At the same time, many participants involved in the projects described future development and expansion options. Several common expansion ideas included offering projects in more districts, considering how to engage underrepresented populations in more ways, and considering how some aspects of computing and technology could be further integrated into more classes. The quotations below paint of picture of some of the expansion ideas shared in interviews and survey responses:

- *We are so thankful that a grant like this exists for us to be able to take these kids into the 21st century technology, that they're going to be able to thrive as they move through schools. Because this isn't something that we could do off of our charter school budget, or parent donations, or anything like that. This isn't anything that we could accomplish through all of our other means. And to be able to have a partner like the STEM Action Center, to be able to do this, just gives our kids such an advantage in life, and we're really, truly thankful for it. (Educator interview)*

- *I also really appreciate the professional learning that we have experienced related to our maker-space equipment. (Educator survey)*

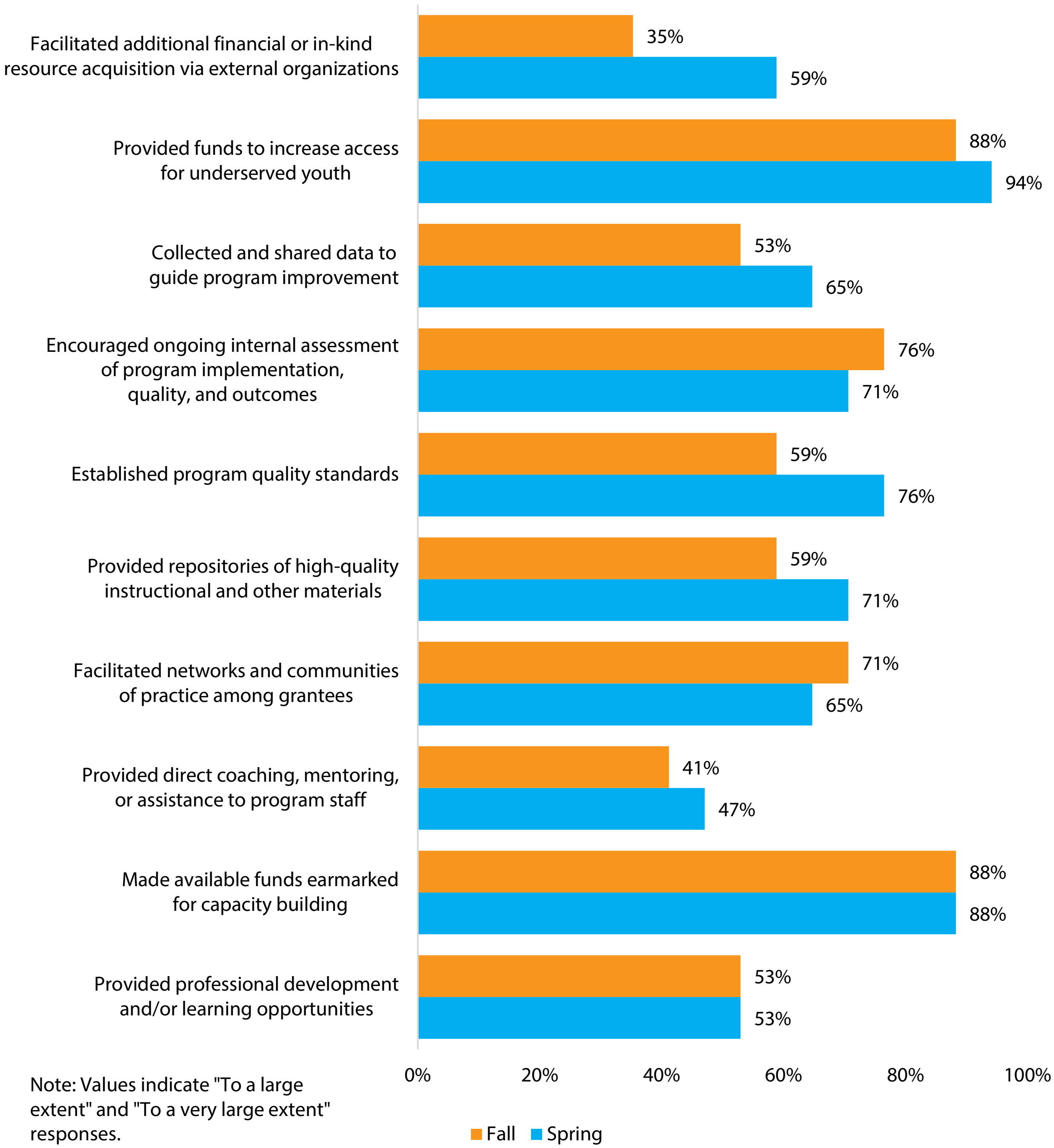
- *[The districts] have that grant are working to connect with and bring programs to their rural students and so, [an educator] actually reached out to me, and we didn't get very far this year, but we have plans, in the next year, for me to actually bring some camps to Richfield area or Emery County. Like, we are actually going to bring our program and run a satellite camp or two and incorporate some computing aspects into our camp for kids in that area who wouldn't otherwise be able to access programs like ours. (Partner interview)*

- *I know the districts kept talking about time. They said, "I have to devote this much to language arts, and I have to devote this much to math, so where else – ?" But one of the things that my lead sensei and I were talking to them about in our initial meetings is that we could layer the coding into math and language arts…Like for example coordinate plane is a huge thing, even in Scratch. So if they're in the geometry section of coordinate planes, you pick that grade level and you have them do spatial stuff. So you can layer it in, and it helps with the understanding on both sides. So it's another thing that could happen in the long run if there's investment in that strategy. (Partner interview)*

Grantee feedback about the STEM Action Center was positive, but varied depending on the form of support

During the fall and spring administrations of the grantee survey, respondents were asked to rate the extent to which the STEM Action Center engaged in a number of activities to build the capacity and practice of school administrators and educators and support the scaling up of computing activities at LEAs. Figure 8 illustrates the proportion of respondents who indicated that the STEM Action Center had engaged in various activities "to a large extent" or "to a very large extent" on a five-point scale including "not at all," "to a small extent," "to a moderate extent, "to a large extent," and "to a very large extent." Although respondents provided positive feedback about the STEM Action Center's ability to provide funds to increase access for underserved youth and make available funds earmarked for capacity building (88-94%), substantially fewer respondents provided high ratings for actions such as direct coaching, mentoring, or assistance to program staff and professional development and/or learning activities at the same level (41-53%). While perceptions of the STEM Action Center varied by activity, responses were consistent over the course of the 2020-21 school year, with one exception. The percentage of grantees reporting that the STEM Action Center facilitated additional financial support via external organizations increased from 35% to 59% from fall to spring.

Figure 8. Grantees' Perceptions of the STEM Action Center



Despite the variation in perceptions of support from the STEM Action Center depending on the specific activity, grantees had positive feedback about the organization's role overall:

- *We appreciate the STEM Action Center and their help in providing assistance and funds to our district to help us expand Computer Science experiences and classes to our students.(Grantee survey)*
- *The personnel from the STEM Action Center has been very available to answer questions and address concerns. This has been particularly helpful during the chaos and difficulty of the COVID-19 shutdowns and quarantine. (Grantee survey)*

- *The STEM Action Center has been awesome! The pandemic has really created a lot of unexpected challenges. (Grantee survey)*

- *We appreciate all of the support that the STEM Action Center provides educators and students. Without their support implementation of CS principles would be difficult! Thank you for all of your help! (Grantee survey)*

- *The STEM AC has been awesome and flexible to adjust to the changing needs as a result of Covid-19 challenges. (Grantee survey)*

Discussion

Summary of Findings

This evaluation of the STEM Action Center's Computing Partnerships Grant Program considered interview data, survey data, and secondary data sources to understand the extent to which educator and student outcomes were achieved, how program implementation varied by district/school, how effective collaborations were, and what role the STEM Action Center played as an intermediary. Key findings are summarized below.

Key Finding #1: Educators reported confidence, satisfaction with teaching, and positive perceptions of the value of computing/technology integration.

The majority of educators reported positive outcomes as a result of their participation in the Computing Partnerships Grant Program. Nearly three quarters of educators agreed with statements pertaining to their confidence with computing instruction. Similarly, three quarters of educators reported positive attitudes toward teaching more broadly. Most educators (85%) agreed that integrating computing and technology into their instruction was of value. Collectively, these findings indicate that the Computing Partnerships Grant Program was a valuable experience for participating educators.

Key Finding #2: Educators reported high levels of competency in some areas, but there is room for further growth in other areas.

As a result of their participation in the Computing Partnerships Grant program, educators reported high levels of competency in their ability to improve their professional practice and collaborate with community partners. In contrast, educators were less likely to report competency in areas such as promoting diversity through inclusive practices and computing/technological practices. This is substantiated by interview findings, where educators expressed interest in additional training opportunities in order to further grow their skills.

Key Finding #3: Computing Partnerships activities continued despite the COVID-19 pandemic.

Educators engaged in problem-solving and identified innovative solutions to ensure program continuity during the COVID-19 pandemic. Programming was adjusted to allow students to continue to safely engage in computing activities. Projects in the design phase were able to continue developing and refining tools and resources. Despite postponement of some activities, grantees expressed optimism about the 2021-22 school year.

Key Finding #4: Although educators observed positive student outcomes in many areas, computational thinking and computing identity may benefit from increased attention

Educators reported high levels of engagement, interest, and confidence among their students. Computational thinking and computing identity, however, were areas of relative weakness for students. Specifically, computational thinking skills such as abstraction and decomposition were relatively low when looking across student outcomes. Within computing identity, performance and competence was another relatively weak student outcome.

Key Finding #5: Program implementation and progress toward program objectives varied across programs.

Many programs made substantial progress toward grant objectives, and educators and partners reported feeling successful about this progress. However, this is still room for further growth. Despite an increase in the proportion of objectives that were met or nearly met over the course of the school year, other objectives have not yet been started or little progress has been made. This may be due, in part, to variation in program implementation across sites. Agreement that LEA communication about shared goals or strategies for improving student outcomes was varied across sites, with just over 30% of educators reporting a lack of clarity in this communication.

Key Finding #6: Collaborations with community partners were critical to program success.

Collaboration with a variety of community partners, which is a core component of the Computing Partnerships Grant Program, was a strength of this year's work. Educators and partners spoke highly of their relationships and the impact that these collaborations had on students. Educators also rated their own competency to engage in collaborations to be quite strong, indicating that this particular grant activity has been an area of success for many projects.

Key Finding #7: The STEM Action Center was successful in supporting the development and expansion of computing in schools through the provision of funding and to a lesser extent, the provision of direct services.

Both educators and grantees agreed that the STEM Action Center supported their efforts to develop and expand computing activities in schools. They noted that the provision of funding, in particular, was critical to their work. Less frequently participants noted other forms of support that the STEM Action Center provided, such as direct coaching or professional learning opportunities. This finding is in alignment with the STEM Action Center's role as an intermediary organization.

Program Considerations

In light of the key findings noted above, we conclude with several program considerations for the Computing Partnerships Grant Program as programming continues into the 2021-22 school year.

Consideration #1: Address lower levels of computational thinking and computing identity among students by increasing opportunities early on for elementary students to participate in computing activities.

Computational thinking and computing identity among students were relatively low compared to other student outcomes. These outcomes may be due, in part, to a lack of developmentally appropriate materials to meet the needs of all students. As such, the Computing Partnerships Grant Program may benefit from increased attention to these areas. Early access to computer science lessons along with opportunities to apply coding concepts in the real-world benefit elementary students' computational thinking and motivation (Tran, 2018). Furthermore, students' computing identities may be strengthened by the provision of activities that provide multiple ways to participate and create a supportive community (DesPortes et al., 2016). By ensuring that robust developmentally appropriate computing opportunities are made available to early elementary students with a variety of participation options, computational thinking and computing identity among participants will be strengthened.

Consideration #2: Continue to invest in Out-of-Classroom Experiences and Innovation & Makerspaces.

Because educators identified Out-of-Classroom Experiences and Innovation & Makerspaces as the most meaningful grant activities for students, future Computing Partnerships programming should continue to invest in these activities. Learning opportunities outside of the classroom provide students with experiential learning opportunities beyond what they might be able to experience in a traditional classroom setting (Dewey, 1987). When students participate in out-of-classroom experiences, they understand content better (Goh & Ritchie, 2011), content is more relevant to them (Lai, 1999), and career interests are influenced (Hutson et al., 2011). Moreover, prior research on the impacts of makerspaces has demonstrated a positive impact on students' STEM literacy (Forbes, et al., 2021), skills, and disposition (Falloon et al., 2020).

Consideration #3: Continue to provide educators with support around technology, resources, and the promotion of diversity in their computing instruction.

For many educators, the ability to promote diversity through inclusive practices was an area of needed growth. Only 61% of survey responses in this domain indicated that educators felt highly competent. Interview and survey data also indicated that educators might benefit from additional support related to technology and resources as well. Because computing access for underserved student populations is a goal of the Computing Partnerships Grant Program, educators may benefit from additional support to ensure that all students are reached, regardless of race/ethnicity, gender, or socioeconomic background. A systematic review of literature by Happe and colleagues (2020) found that girls, for example, may benefit from educators who combat incorrect stereotypes, spark interest in computing, appropriately introduce computing topics, create a supportive learning environment, and build self-confidence. Additionally, Corkin and colleagues (2020) found that an intervention informed by culturally relevant pedagogy encouraged computer science motivation among underrepresented students through the integration of culture, art, and geometry with coding. These findings demonstrate the variety of ways that Computing Partnerships educators might strengthen their ability to reach diverse students in their computing instruction.

Consideration #4: Continue to provide support for COVID-related challenges.

The COVID-19 pandemic led many programs to redesign learning activities for students. For instance, rather than students attending field trips, learning experiences were provided on-site at schools or virtually in some cases. Going forward, these adjustments may continue to be beneficial as programs strive to provide computing opportunities for all students, particularly underserved populations, throughout the pandemic. For example, while rurality has historically been a barrier to student participation in computing activities (Google Inc. & Gallup Inc., 2015) programs may overcome this challenge by finding creative ways to provide learning opportunities virtually or on-site. Interactive online learning resources may support educators in engaging students with computing content virtually throughout the pandemic and beyond (Fasy et al., 2020).

Consideration #5: Ensure meaningful professional learning to expand computing knowledge, expertise, and integration of computing content into other subject areas.

Educators noted the importance of engaging in timely and relevant professional learning that expanded their repertoire of teaching practices, including their ability to integrate computing activities into other subject matter areas. The Computing Partnerships Grant Program aided in the development of innovators, explorers, and local experts. As a result of their participation in the program, educators developed their capacity to provide peer-to-peer and programmatic professional learning. The STEM Action Center, as an intermediary, can serve as a convenor for these types of professional learning opportunities. While the COVID-19 pandemic presented unique challenges for educators, it also afforded the adaptation of program design and communication avenues. Consequently, virtual professional learning may be an alternative format to ensure greater accessibility throughout the state.

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Appendix A: Project Objectives and Outcomes

Project Name and District	Project Objectives and Outcomes
Building a Computing Culture: *Jordan District*	**Objective A-** Increase teacher training, support, and resources (including Makerspaces) to teach computing Outcome - Participating teachers/specialists have an awareness of resources and how to integrate and align them into the new Computer Science standards, cross-disciplinary into regular core standards, and expand into Makerspace and after-school programs **Objective B-**Outreach to underrepresented students to integrate out of school and classroom training Outcome - Participating teachers/specialists have developed best practices related to STEM/CS resources and how to integrate them into CS standards; this integration will allow delivery of resources to a wider audience of students and facilitate the development school-based makerspaces **Objective C –** Build and maintain a coalition of community partners to accomplish goals and provide pathways for students Outcome - Individual schools will build relationships and partners with businesses and industry partners in their local school community
Code2Create Partnership Grant: *Iron District*	**Objective A-** Increase teacher training, support, and resources (including Makerspaces) to teach computing Outcome - 100% of Elementary Teachers and Middle School CS Teachers will be trained and have the resources they need to teach computing skills **Objective B-** Outreach to underrepresented students to integrate out-of-school and classroom training Outcome - Traditionally underrepresented students will increase representation in our computing events and programs by 10% **Objective C-** Build and maintain a coalition of community partners to accomplish goals and provide pathways for students Outcome - Our partnerships and opportunities to engage with partners will increase by100%
Code to Success, Elementary Coding, Computer Science Professional Development for Teachers, and Mobile Makerspace:	**Objective A- Expand high school summer program "Code to Success"** Outcome: Code to Success involves three 120-hour online sessions resulting in a Coding Credential if satisfactorily completed. Code to Success supplements and complements our CTE Computer Science classes, and generates interest in CS pathways; it helps students to earn CS credentials or certificates. Program completers are able to transition to CS college programs or the CS workforce **Objective B – Conduct after-school coding activities in elementary schools with parents** Outcome: Elementary students will participate in a variety of computing activities that will allow them to better understand computers and use them in all aspects of their school work and lives. Parents, stakeholders, and community partners shall be included in some activities **Objective C – Provide professional development for our out-of-school K-5 teachers that supports integration of the K-5 CS Standards**

Project Name and District	**Project Objectives and Outcomes**
San Juan District	Outcome: All K-5 teacher will be able to integrate the K-5 CS Standards in all subject areas **Objective D – Create mobile makerspace so students will have equitable access to key materials and equipment** Outcome: Maintain a mobile makerspace so that all students and schools have equitable access to specific materials and equipment that schools would otherwise not be able to purchase, maintain, and/or have space to store these materials and equipment
Coding in Kearns: *Granite District (Kearns)*	**Objective A- Create formalized pathways for students from underrepresented groups to learn coding and robotics in grades PreK-12th** **Objective B – Create Maker spaces** **Objective C - Provide high quality professional development opportunities for teachers in order to improve teacher quality and retain highly qualified educators**
Computing Expeditions Consortium: *Entheos Academy/ Pacific Heritage Academy*	**Objective 1 – Provide collaboration between afterschool programming and community/higher education experts in computing and experiential learning** **Objective 2- Enable out of school time educators to access curriculum and tools to better integrate learning with USBE K-12 Computer Science Framework and develop strong computing teaching skills** **Objective 3 – Provide afterschool engagement with computing from the earliest grades through middle school** **Objective 4 – Provide strong connection between the school day and after-school program** **Objective 5 – Provide access to computing for all students, including students who are traditionally underserved in the field** **Objective 6 – Use near-peer role models to encourage participation and increase the perception of belonging in computing** **Objective 7 – Provide a strong experiential computing model that parallels and integrates with the learning models used in teaching all subjects**
Computer Science Experience for Underserved Students in Duchesne County Elementary Schools: *Duchesne District*	**Objective A- Weekly after school 4-H Computer Science Club Meetings** Outcome- Students consistently participate in CS club meetings **Objective B – Participation in an International Scratch Day Event** Outcome- Students will understand the global nature of computer science **Objective C – Participation in a FIRST LEGO League Jr. Robotics Showcase Event** Outcome- Teachers and students will participate in a FIRST LEGO League Jr. Robotics Showcase Event **Objective D – Summer 4-H Computer Science Summer Camps** Outcome- Students and teachers will participate in a 4-H Computer Science Summer Camp each summer **Objective E – Teachers participate in one professional development activity per quarter/semester**

Project Name and District	Project Objectives and Outcomes
	<u>Outcome</u>- Teachers will become more acquainted with Computer Science and will be able to incorporate PD activities in their Computer Science club meetings and will learn how to integrate Computer Science principles in other core curriculum
COVE 21 (Maker Space/STEM Room): *South Sanpete District* **COVE 21 (Maker Space/STEM Room):** *South Sanpete District …continued from previous page*	**Objective A- Develop a maker space that helps prepare all students for the workforce by developing computing, programming, and 21st Century skills.** <u>Outcome</u>- Our desired outcome is to create a 21st Century Makerspace that provides all students, including underserved student populations, with access to high quality materials and instruction in order to develop computing, programming, and 21st Century skills **Objective B – Develop and implement high quality lessons and activities in areas of computing, programming, and STEM related topics within the maker space.** <u>Outcome-</u> Provide high quality, age appropriate computing and programming activities to all students **Objective C – Increase the number of students who have access to computing and STEM activities including underrepresented groups of students.** <u>Outcome-</u> Ensure that every student, including underrepresented student populations, at Manti Elementary are active participants in meaningful computing and programming lessons throughout the grant period within our makerspace **Objective D – Provide students with real life problems that require innovative responses and solutions.** <u>Outcome</u>- Students will develop critical thinking, collaboration skills and use their creativity in order to find innovative solutions to 'real world' problems on a quarterly basis **Objective E – Support Core instruction through appropriate use of computing activities, STEM activities, and other appropriate activities** <u>Outcome-</u> Lessons and activities in the makerspace will not only support but also enhance Core content in academic areas that include Language Arts, Mathematics, Science, and others **Objective F – Increase the number of teachers who access and use computing and STEM tools.** <u>Outcome-</u> The desired outcome is that more teachers will use computing, programming, and STEM tools in their respective classrooms **Objective G – Provide Professional Development Opportunities to teachers, staff, and school leadership to increase proficiency in computing and STEM** <u>Outcome</u>- Increase the number of school personnel that attend professional development trainings focused on computing, programming, and STEM tools and skills **Objective H – Maintain positive relationships with current and future partners through quality outreach and marketing strategies** <u>Outcome</u>- Our outcome is to build and maintain positive relationships with our current and future partners to help ensure the sustainability of our program **Objective I – Actively seek new partnerships with businesses, post-secondary institutions, community resources and other schools in supporting computing efforts.** <u>Outcome</u>- We recognize that we cannot fully accomplish our objectives without maintaining and building new relationships. We hope to find new partnerships with numerous parties to ensure sustainability of the program and enhance what we can offer our students and partners

Project Name and District	Project Objectives and Outcomes
CS Outreach and Retention Plan: *Weber District*	**Objective A- Create Summer Camps and Teacher Training** Outcome- Each year have 3 summer camps and 2 days of programming training for coaches **Objective B — Support After School Clubs** Outcome — Help provide missing equipment, training, and pay coaches to run after-school club
Establishing a Computer Science Pathway for Underserved Students in: *Washington District (Hildale)*	**Objective A- Establish a robust computing program with emphasis on computational thinking.** Outcome- A computer science program is implemented and students are participating **Objective B – Professional development training for all teachers, paraprofessionals and volunteers organized by Dixie State University in collaboration with Utah State University Extension's 4-H program.** Outcome- Teachers are trained in computing and continuing to learn the art of computing **Objective C – Implement curriculum on cs-first.com, exploringcs.com, codechangers.com, and code.org.** Outcome- Teachers are implementing computing and students are seeing it used and relating to real world situations
Expanding Computational Thinking in Juab SD: *Juab District*	**Objective A-** Outcome – Increased computational thinking expertise in educators who have earned micro-credentials **Objective B –** Outcome – Increased classroom use of computational thinking by educators who have earned micro-credentials
Expanding Computer Science Pathway for Students in Kane County School District: *Kane District*	**Objective A- Increase student (and community) engagement in computing through the following hands-on, educational activities and events:** Outcome - Increased participation in computing activities throughout the County **Objective B – Development of Maker Space** Outcome – Increased use of Kane County 4-H Makerspace
Hurricane Cone Site Pipeline for Computer Science: *Washington District*	**Objective A- Provide before/after school programs** Outcome- Students will compete in the robotics competition and show proficiency in computing skills at code camps **Objective B – Provide professional development for computing facilitators** Outcome- Facilitators will gain greater computing skills **Objective C – Collaborate with secondary education to provide mentorship/internship opportunities** Outcome- Mentorship and internship hours for sterling scholarship applications

Project Name and District	Project Objectives and Outcomes
Murray PowerPlay: *Murray District*	**Objective A — Increase the number of maker space structures at each elementary school and junior high over the course of the grant.** Outcome- Increased number of K-9 students who are able to participate in a maker space to apply computing principles during after school activities **Objective B- Increase the number of occurrences for PowerPlay interns to have access to internship opportunities with industry partners and provide experiences and skill enhancement in the workplace that lead to post-secondary employment** Outcome- Increased number of students who choose computer science as a career **Objective C — Increase the number of opportunities elementary students K-6 have access to the Computer Science Standards.** Outcome- Increased number of K-6 students who are able to participate in an afterschool program using computer science
Pinnacle Designs: *Pinnacle Canyon Academy* **Pinnacle Designs:** *Pinnacle Canyon Academy …continued*	**Objective A- To provide outreach, student engagement and student retention to Pinnacle Canyon Academy (PCA) students.** Outcome- Pinnacle will add computing activities for secondary students through the afterschool program and in the summer. The master schedule will reflect the change and the building will remain open until 6:00 p.m. nightly **Objective B - Create Maker Space** Outcome- Pinnacle Canyon Academy will create a Maker space in the elementary for all students in elementary to access and use that will encourage youth to be creative, develop critical thinking skills, improve communication and increase collaboration **Objective C - Provide opportunities for relevant Industry Involvement** Outcome- Pinnacle will provide buses for twelve field trips to visit work sites and develop twenty-five internship sites with Future IN Design for students to complete a paid internship **Objective D – Create mobile makerspace so students will have equitable access to key materials and equipment** Outcome: Maintain a mobile makerspace so that all students and schools have equitable access to specific materials and equipment that schools would otherwise (1) not be able to purchase, (2) maintain, or (3) have no space to store these materials and equipment

Project Name and District	Project Objectives and Outcomes
The Portable Universe of Computing, Computing Science, STEM and Coding: *CUES*	**Objective A – Student Learning with Computing through a Mobile Innovation Space** ; <u>Outcome</u>: Provide students with practical coding and other computing opportunities through the use of a mobile planetarium **Objective B- Training/Professional Development** <u>Outcome</u>: CUES and at least one representative from each of our 7 school districts will receive an initial Digitalis Planetarium training on the hardware and software use, and be instructed on how to provide innovative learning experiences for students **Objective C – Community Partnerships and Collaboration** <u>Outcome</u>: Establish partnerships with higher ed (*Snow College, SUU, USU*), industry (*ACT Aerospace, Space Dynamics Lab, Hill Air Force Base, Planetary Science Institute, Northrop Grumman*) and community (*Sevier CTE Center, CodeChangers, Fremont Indian State Park, Richfield Residential Hall*) entities
Project-Based Learning Makerspaces: *Weilenmann School of Learning*	**Objective A- WSD will create maker spaces over the course of the award years that will enable students to learn and apply computational knowledge, critical thinking, and authentic application** <u>Outcome</u>- Support of Implementation of K-8 Computer Science Standards at WSD **Objective B – WSD will increase equitable access to computing learning and application at the school and within the school community** <u>Outcome</u> – All students at the school will have access to maker spaces for learning of computer science standards and for equitable access to knowledge, skills, and application **Objective C – WSD will establish community partnerships with experts for training and with parents and families for education and application of skills and knowledge** <u>Outcome</u> – Establishment of four, productive community partnerships related to computer science and traditional skills between the school and community
Work-Based Learning Internships and Certifications in 6 Rural Utah Districts: *SEDC*	**Objective A- Provide a framework for students at participating schools to develop IT-related career skills during high school** <u>Outcomes</u>- Each LEA will employ at least one paid intern. Each paid intern will complete an IT certification course and certificate based on their job role

Note: Two programs, Coding in Kearns and Computing Expeditions Consortium, did not provide outcomes.

Appendix B. Pilot Student Survey Results

As noted in the Methods section of this report, this year's administration of the UEPC Student Computing Survey was a pilot. Similar to the questions asked of PK-5 educators in the UEPC Educator Computing Survey, students were asked to rate their level of agreement with statements measuring computing self-efficacy, computing interest, computing engagement, computational thinking, and computing identity. We remind the reader that we only received nine responses from middle school and high school students in a single district. While we have summarized pilot student survey responses below in Table 9, we cannot draw any conclusions from this survey administration as we only received nine responses. The UEPC will offer this survey to all students whose educators are part of the Computing Partnerships Grant Program in 2021-22.

Table 11. Pilot Student Survey Results

Construct	Number of Survey Items	Average Response	% of Responses in Agreement
Computing Self-Efficacy/Self-Confidence	9	3.8	68%
Computing Interest	11	3.9	61%
Computing Engagement	12	3.6	63%
Computational Thinking:			
Abstraction	3	3.9	73%
Algorithmic Thinking	3	4.1	93%
Decomposition	3	3.1	40%
Pattern Recognition	3	3.7	80%
Evaluation	3	3.9	87%
Computing Identity:			
Recognition	4	3.4	50%
Interest	3	2.7	20%
Performance/Competence	3	3.5	47%
Goal/Outcome Expectation	2	2.7	40%

Note: "Average Response" is on a scale of 1-5, where 1=strongly disagree, 2 =disagree, 3=neither agree nor disagree, 4 =agree, and 5=strongly agree. "% of Responses in Agreement" represents the percentage of responses that were either "agree" or "strongly agree" for each measure.

2021

Advancing STEM Teaching and Learning in Utah: An Evaluation of the STEM Action Center's Professional Learning Grant Program, 2020-21 School Year

Prepared by the Utah Education Policy Center
on behalf of the STEM Action Center

October 2021

THE UNIVERSITY OF UTAH
UTAH EDUCATION POLICY CENTER

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UTAH EDUCATION POLICY CENTER

Bridging Research, Policy, and Practice

The Utah Education Policy Center (UEPC) is an independent, non-partisan, not-for-profit research-based center at the University of Utah founded in the Department of Educational Leadership and Policy in 1990 and administered through the College of Education since 2007. The UEPC mission is to bridge research, policy, and practice in public schools and higher education to increase educational equity, excellence, access, and opportunities for all children and adults.

The UEPC informs, influences, and improves the quality of educational policies, practices, and leadership through research, evaluation, and technical assistance. Through our research, evaluation, and technical assistance, we are committed to supporting the understanding of whether educational policies, programs, and practices are being implemented as intended, whether they are effective and impactful, and how they may be improved and scaled-up, and become sustainable.

Please visit our website for more information about the UEPC.

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The UEPC thanks Kellie Yates from the STEM Action Center for providing essential insights about the Professional Development Grant and serving as a liaison between the evaluation team and the STEM Action Center's partner schools and districts. We appreciate the educators and students from participating districts who provided feedback on their experiences with the Professional Learning Grant Program.

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Tables and Figures

Introduction

Professional Learning Grant Program Overview

Since 2016, the Utah Education Policy Center (UEPC) has been contracted by the STEM Action Center to evaluate the effectiveness of the STEM Action Center's Professional Learning Grant Program. The purpose of this evaluation is to understand the implementation of the program and associated educator and student outcomes. This year's evaluation builds upon previous years with the addition of educator interviews and more extensive survey data collection, including a UEPC Educator STEM Professional Learning Survey, Student STEM Survey, and Educator Collaboration Self-Assessment Survey.

As the administrator of the professional learning provision of the H.B. 150, since 2014 the STEM Action Center has provided online, hybrid, and face-to-face professional learning opportunities for K-12 teachers, including:

- providing teachers access to tools, resources, and strategies;
- fostering opportunities for teachers to work in online learning communities;
- tracking and reporting data on usage of the application's components; and
- allowing the USBE, school district, or school to track results of the professional learning.

Among the bill's 2017 provisions was a mandate that the STEM Action Center provide high quality STEM education professional learning to K-12 educators. According to the STEM Action Center, this mandate is addressed through awarding one-year or three-year grants to schools and districts who apply and are selected based on identified priorities associated with STEM learning and the schools'/districts' unique STEM-related needs. Grantees have a requirement that grant-funded professional learning activities are video-recorded and uploaded for the purpose of self-reflection. In the past year, the STEM Action Center awarded new grants and continued supporting ongoing grants, indicating that the STEM Action Center's Professional Learning Grant Program is reaching new audiences. The 2020-21 evaluation of the Professional Learning Grant Program used a mixed-method design (i.e., interviews, surveys, and secondary data sources) to answer the following evaluation questions:

- How is STEM Professional Learning implemented across LEAs, in terms of guiding theories of action, values/vision, collaboration, relational conditions, leadership involvement, coaching, use of standards-based content, consistency, and adherence to adult learning principles and professional learning standards?
- How effective is STEM Professional Learning in increasing teacher outcomes in efficacy, confidence, STEM knowledge, STEM identity, skills and application of skills, collaboration, and planning and integration of STEM content?
- To what extent do students in classrooms/programs of teachers who have received STEM Professional Learning demonstrate increases in STEM interest, engagement, confidence, STEM identity, and achievement as a result of teachers' participation in STEM Professional Learning?
- What is the role of the STEM Action Center as an intermediary in facilitating and/or supporting STEM Professional Learning?

Relevant Literature

As noted in a recent evaluation of the Professional Learning Grant Program by the Utah Education Policy Center (UEPC),[1] compared to students in other countries, students in the United States underperform on tests of scientific and, especially, mathematics, literacy (National Science Board, National Science Foundation, 2019). This raises a challenge for the K-12 STEM educator workforce in the United States whose members often do not hold degrees in the STEM subject areas they teach (Hossain & Robinson, 2012; Leyzberg & Moretti, 2017; Swars et al., 2016) and, as a result, K-12 students are frequently instructed by educators who do not have sufficient STEM content knowledge (Berry III et al., 2014; Jensen et al., 2016; Joshi & Jain, 2018).

In an effort to address K-12 STEM educators' lack of STEM expertise, conventional professional development and professional learning communities have been implemented (Burrows, 2015; Chiyaka et al., 2017; Fulton & Britton, 2011; Hudley & Mallinson, 2017). However, scholars have identified a number of shortcomings to the United States' approach to STEM professional learning (Hiebert & Stigler, 2017; Maltese et al., 2013; Rogers et al., 2016). Other nations, such as mainland China, Hong Kong, and Taiwan, might serve as models for professional learning in the United States (e.g., Jensen et al., 2016a; Jensen et al., 2016b). Activities such as mentorship and content-specific training may be beneficial (Chiyaka et al., 2017; Jensen et al., 2016a).

Effective STEM professional learning supports educators to create authentic STEM learning experiences for students (Fulton & Britton, 2011; Rogers et al., 2016). These experiences also increase educators' awareness of STEM careers, provide them with mentorship opportunities, and build their STEM knowledge (Burrows, 2015; Chiyaka et al., 2017; Fulton & Britton, 2011; Nadelson et al., 2013; Nathan et al., 2011; Webb, 2015). Educators who participate in effective STEM professional learning are better able to improve and sustain their students' learning, achievement, and interest in STEM subjects (Capraro et al., 2016; Estapa & Tank, 2017; Fulton & Britton, 2011; Jensen et al., 2016a).

More recently, efforts to provide effective professional learning have been transformed by the COVID-19 pandemic. The move to virtual learning settings for students and educators has led to shifts in both the format and aims of professional learning. A national study by Kraft and Simon (2020) found that professional learning has increasingly focused on supporting remote instruction and students' social-emotional well-being. Educators engaging in professional learning during the COVID-19 pandemic also expressed a need for strategies to address the loss of hand-on learning opportunities for students and to support students' social and emotional learning needs (Hamilton et al., 2020). Recent research on online STEM professional learning communities identified the importance of frequent video posting, types of videos shared, and the style of reflection questions as important aspects of these collaborations. Educators who participated in online PLCs reported increased efficacy, and participants reported enjoying and valuing the program (Durr et al., 2020).

[1] Onuma, F. J., Rorrer, A. K., Pecsok, M., Weissinger, K., & Auletto, A. (2020). *Advancing STEM Teaching and Learning in Utah: An Evaluation of the Impact of the Professional Learning Grant Program.* Utah Education Policy Center: Salt Lake City, UT.

Methods

Evaluation Questions

This mixed-method evaluation used interviews, surveys, and secondary data sources to answer evaluation questions about the implementation and outcomes of the Professional Learning Grant Program. In this report, we provide an analysis of program implementation, educator and student outcomes, and the STEM Action Center as an intermediary organization. Table 1 contains a summary of our evaluation questions as well as data sources. As noted in the table, we organize our findings into three sections: program implementation, educator and student outcomes, and the STEM Action Center as an intermediary organization.

Table 1. Evaluation Questions and Data Sources

	Evaluation Questions	Data Sources					
		STEM AC Personnel Interviews	**Educator Interviews**	**Student Surveys**	**Educator Surveys**	**Collaboration Self-Assessment**	**Secondary Data**
Evaluation Questions	**Program Implementation**						
	How is STEM Professional Learning implemented across LEAs, in terms of guiding theories of action, values/vision, collaboration, relational conditions, leadership involvement, coaching, use of standards-based content, consistency, and adherence to adult learning principles and professional learning standards?		✓		✓	✓	
	STEM Educator and Student Outcomes						
	How effective is STEM Professional Learning in increasing teacher outcomes in efficacy, confidence, STEM knowledge, STEM identity, skills and application of skills, collaboration, and planning and integration of STEM content?	✓	✓		✓		
	To what extent do students in classrooms/programs of teachers who have received STEM Professional Learning demonstrate increases in STEM interest, engagement, confidence, STEM identity, and achievement as a result of teachers' participation in STEM Professional Learning?	✓	*	✓			
	STEM Action Center as an Intermediary						
	What is the role of the STEM Action Center as an intermediary in facilitating and/or supporting STEM Professional Learning?	✓	✓		✓		

* Educator survey responses regarding student outcomes will be included in the Fall 2021 addendum report described following this table.

In a Fall 2021 addendum report, we will also address two research questions:

- How does the retention and mobility of teachers who participate in STEM Professional Learning compare to nonparticipants?
- How do the credentials of STEM Professional Learning participants compare to nonparticipants?

This report will be informed by Fall 2021 CACTUS records and will provide an analysis of retention and mobility, as well as credentials of participants in the Profession Learning Grant Program. In this report, we will also provide a summary and analysis of educator survey responses about student outcomes.

Data Sources & Analysis

To address our evaluation questions, data were collected using instruments designed by the Utah Education Policy Center (UEPC). These instruments included the UEPC Educator STEM Professional Learning Survey, the UEPC Student STEM Outcome Survey, the UEPC Collaboration Self-Assessment, an interview protocol, and secondary data sources (i.e., CACTUS data records). The UEPC Educator STEM Professional Learning Survey served as the primary means of data collection and garnered a total of 1,128 responses. When two or more data sources were analyzed to address a particular evaluation question (see Table 1), we utilized a triangulation approach to verify the consistency of findings obtained through different data collection approaches. In the following sub-sections, we describe each data source and the accompanying analytic strategy.

UEPC Educator STEM Professional Learning Survey

Districts and schools participating in the Professional Learning Grant Program identified 3,284 educators and administrators to participate in a UEPC Educator STEM Professional Learning Survey. In the spring of the 2020-21 school year, these individuals were invited via a direct email to complete the survey. The UEPC Educator STEM Professional Learning Survey contained questions that were aligned with educators' professional learning experiences, including topics such as participant use of video reflection, instructional planning time, attributes of their STEM professional learning, self-reported educator outcomes, and student outcomes. The administrator version of this survey asked administrators to respond to items about their perceptions of the STEM Action Center and their educators' participation in the program (i.e., proportion who participated in professional learning and video-based reflection). The specific content of the UEPC Educator STEM Professional Learning Survey is presented in more depth in our findings. Analysis of these items included the generation and interpretation of descriptive summary statistics to identify common trends in responses across topics. Survey respondents were also asked if they had anything that they would like to add upon completion of the survey. Their open-ended responses were open- and focused-coded and thematically integrated into this report.

We received 1,128 responses, resulting in a 34% response rate. Participants were asked to self-identify as educators or administrators. Educators represented 98% of participants (n=1,103) and administrators represented the remaining 2% (n=25). Although participants were de-identified for analysis and reporting, use of *Comprehensive Administration of Credentials for Teachers in Utah Schools* (CACTUS) information permitted us to report educator and school characteristics. Of the 1,103 participating educators, we were able to match 1,038 records in CACTUS records, resulting in a 94% match rate. Records that were not able to be matched may have occurred due to the inclusion of non-certified educators (e.g., paraprofessionals, aides) or incorrect CACTUS IDs. Participants represented 31 unique districts/charter schools. Most participants (91%) were employed in traditional public school districts, while the remaining 9% were employed in charter schools.[2]

Educator Survey Participant Demographics

The figures and tables in this section of the report provide a summary of participant demographics. Most participants (85%) were female. Male educators were more commonly observed teaching secondary grade levels. Participants tended to be veteran teachers; 44% of educators had more than 10 years of experience and 23% had six to ten years of experience. Overwhelmingly, participants were White (91%). Just under one third of participants (31%) had a graduate degree. Just over half of participant taught math and science (53% and 52%, respectively), while technology and engineering were less commonly taught (40% and 29%, respectively). Among elementary educators specifically, 13% held a mathematics endorsement, 9% held a STEM endorsement, and 6% held an educational technology endorsement.

Figure 1. Educator Survey Participant Gender

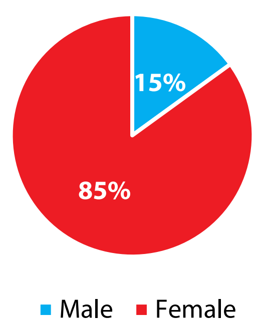


Figure 2. Educator Survey Participant Position Type by Gender

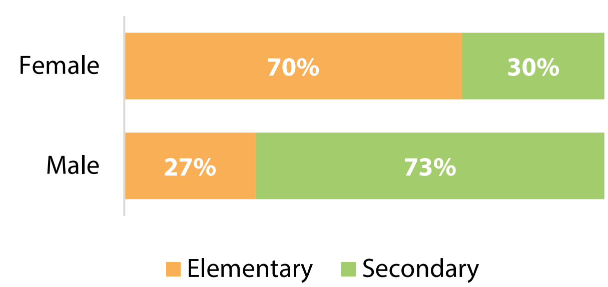


Figure 3. Educator Survey Participant Experience

[2]The UEPC maintains a Data Sharing Agreement (DSA) with the Utah State Board of Education (USBE) wherein the USBE permits student, school, and staff de-identified data with the UEPC for the purposes of state, district, and federal evaluations. The views expressed in this report are those of the authors and are not necessarily the USBE's or endorsed by the USBE.

Table 2. Educator Survey Participant Race/Ethnicity

Race/Ethnicity	Proportion of Participants
White	91%
Unknown	4%
Hispanic	3%
Asian	2%
American Indian	<1%
Black	<1%
Pacific Islander	<1%

Figure 4. Educator Survey Participant Educational Attainment

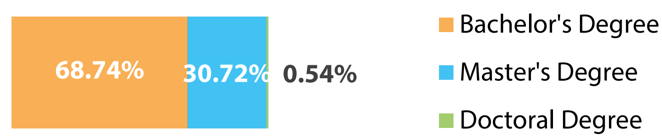


Figure 5. STEM Subjects Taught by Educator Survey Participants

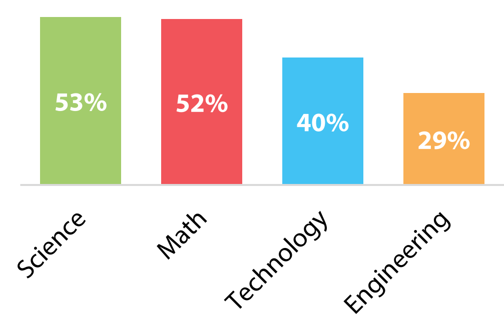
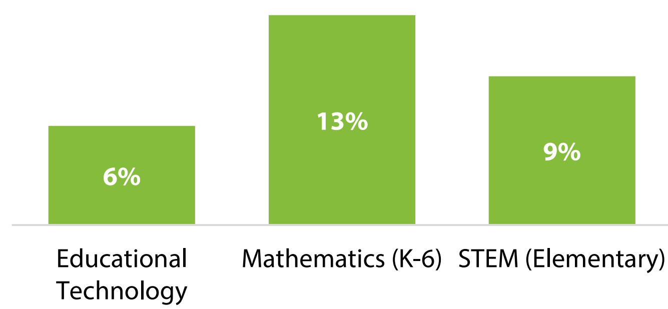


Figure 6. STEM Endorsements among Elementary Educator Survey Participants



UEPC Collaboration Self-Assessment Survey

Educators who participated in the Professional Learning Grant Program during the 2020-21 school year (n=3,284) were invited to complete the UEPC Collaboration Self-Assessment Survey during the fall and spring. The UEPC Collaboration Self-Assessment Survey was developed by the UEPC in 2018 as part of its ongoing work in the area of district and school improvement. The UEPC Collaboration Self-Assessment Survey instrument was intended to measure changes in collaboration practices over the course of the school year in six domains:

- Capacity building
- Empowerment
- Intentional
- Improvement-focused
- Inquiry-based
- Collective responsibility

While the Fall 2020 administration of the survey aimed to determine collaboration program-wide, spring administration included direct administration to participants at their sites in an effort to provide more refined results that could inform program implementation and improvement by site and district. Spring results could not be linked to fall responses for comparative analyses. Thus, we are not able to compare individuals' responses in the fall to their responses in the spring.

The fall administration yielded 303 responses and the spring administration yielded 430 responses. Out of the 26 unique districts that participated in the survey, 14 districts had responses in both the fall and the spring while the remaining 12 districts only participated at one point in time. Only five districts had at least 10 respondents at both points in time. Due to varying response rates and small sample sizes, this report focuses on overall results, rather than individual results by district. However, STEM Action Center personnel and district personnel have been provided with access to district-level results via an electronic data dashboard to support program implementation and improvement. In addition to the STEM Action Center's ability to view a summary of responses across domains in the survey, districts are also able to view their individual results and aggregated program-wide results.

Our analyses of these data include the generation and interpretation of descriptive statistics. Specifically, we calculated composite measures of survey responses by domain (i.e., capacity building, empowerment, intentional, improvement-focused, inquiry-based, and collective responsibility) and point in time (i.e., fall, spring). We also conducted two-sample t-tests to compare survey responses in the fall and spring. This analysis allowed us to determine whether there were statistically significant changes in self-reported collaboration over the course of the 2020-21 school year. Results are discussed in more depth in our presentation of results later in this report.

UEPC Student STEM Outcome Survey

A UEPC Student STEM Outcome Survey was piloted in a single district during the 2020-21 school year. This survey intended to measure student interest, engagement, confidence, identity, and achievement in STEM. Each construct was measured through multiple survey items (5 to 11 per construct). We used exploratory factor analysis to refine the UEPC Student STEM Outcome Survey for future evaluations of the Professional Learning Grant Program. As illustrated in Table 2, this analysis resulted in eliminating survey items in some cases to strengthen our ability to consistently measure student outcomes in STEM interest, engagement, confidence, identity, and achievement. Cronbach's alpha is a measure of how related items are to each other, where values closer to 1 indicate a stronger relationship. We will utilize the UEPC Student STEM Outcome Survey for our evaluation of 2021-22 programming, including administering an updated version of the student survey reflecting the retained survey items.

Table 3. Pilot Student Survey Adjustments

STEM Construct	Original Survey Items	Retained Survey Items	Cronbach's Alpha of Retained Survey Items
Interest	8	4	0.93
Engagement	9	5	0.88
Confidence	5	5	0.86
Identity	11	8	0.94
Achievement	5	5	0.89

All survey items were on a five-point scale ranging from "strongly disagree" to "strongly agree." Within each of the five STEM constructs included in the survey, we calculated the percentage of responses that were either "agree" or "strongly agree." Further interpretation is provided in our presentation of findings.

We received a total of 88 responses in the pilot administration of UEPC Student STEM Outcome Survey. As noted in Table 3, participants were in grades 6-12. We conducted a two-sample t-test of our results, comparing responses of those in grades 6-8 to those in grades 9-12. We did not find any significant differences. As such, our presentation of findings describes student results for the entire group, and we do not disaggregate by grade level.

Table 4. Student Survey Participants' Grade Levels

Grade Level	N
6	19
7	18
8	11
9	1
10	10
11	16
12	13
Total	**88**

Educator Interviews

The 2020-21 evaluation included interviews and focus groups with participants of the Professional Learning Grant Program to address key evaluation questions. The purpose of these interviews was to gain a deeper and more nuanced understanding of how the Professional Learning Grant Program was implemented from the perspective of those in the field. A semi-structured interview protocol was developed to gather information about participants' experiences with implementation as well as suggestions for improving the grant program and for future planning.

Respondents to the UEPC Educator STEM Professional Learning Survey were asked if they would be interested in participating in an interview or focus group. Of the survey respondents, 29 participants indicated an initial willingness to participate in a follow-up interview. Four educators responded to the invitation to voluntarily participate in an interview and completed consent forms. In addition, the UEPC was able to interview one representative from the STEM Action Center. Interviews ranged from approximately 45 minutes to one hour. All interviews were conducted virtually via Zoom, and each was recorded and transcribed for analysis. Analysis included the use of both open-coding and focused-coding based on the evaluation questions to generate themes (Saldaña, 2016). Due to the small interview participant sample size, we have integrated illustrative interview quotes throughout this evaluation report, rather than presenting a standalone analysis of interview findings.

Secondary Data

The UEPC used CACTUS data, as permitted through the UEPC DSA with USBE, along with publicly available school data, to generate summary characteristics of Professional Learning Grant Program participants and sites. All characteristics were analyzed and presented in an aggregated format to protect the privacy of participants. These data allowed us to identify any differences in experiences with the program by teacher characteristic or school setting.

Program Implementation

How is STEM Professional Learning implemented across LEAs, in terms of guiding theories of action, values/vision, collaboration, relational conditions, leadership involvement, coaching, use of standards-based content, consistency, and adherence to adult learning principles and professional learning standards?

To understand how implementation of the Professional Learning Grant Program varied across program sites, we analyzed data from the UEPC Educator STEM Professional Learning Survey, educator interview data, and results from the UEPC Collaboration Self-Assessment, a survey that was administered to educators in both fall and spring of the 2020-21 school year.

These data sources sought to understand how the program was implemented across districts and schools in terms of guiding theories of action, values/vision, collaboration, leadership involvement, coaching, use of standards-based content, consistence, and professional learning that reflects adult learning principles.

Educators generally reported positive perceptions of the Professional Learning Grant Program's implementation

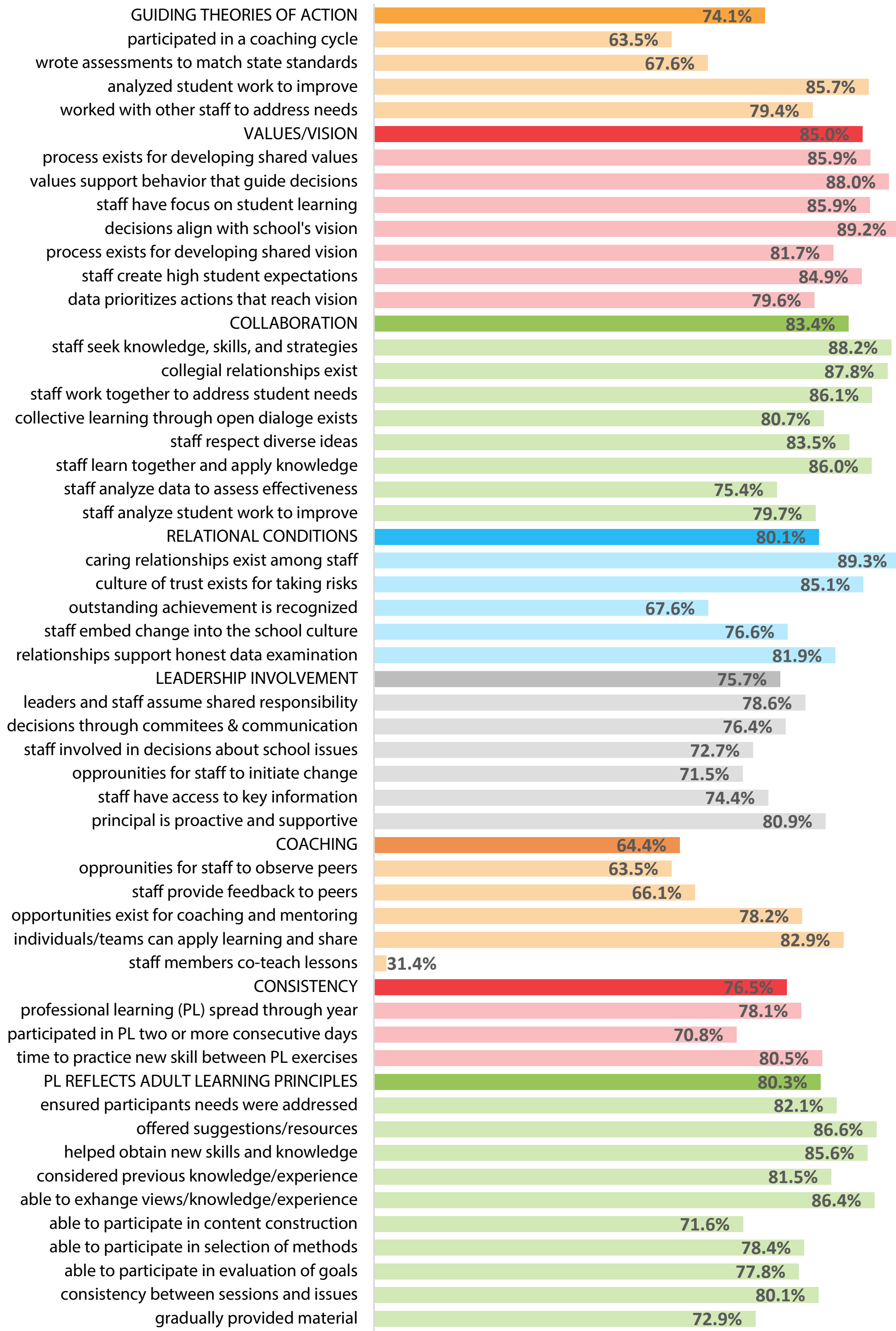
"STEM professional learning has guided me to provide a learning environment that will help students succeed in the future." (Educator survey)

Educator survey participants responded to various items measuring their perceptions of the implementation of the Professional Learning Grant Program. We begin our discussion of survey results with a high-level overview of educators' perceptions of guiding theories of action, values/vision, collaboration, relational conditions, leadership involvement, coaching, consistency, and professional learning that reflects adult learning principle (Figure 7).

Each value in this figure represents the percentage of "agree" and "strongly agree" responses submitted by educators. For example, 74.1% of respondents agreed with items measuring perceptions of guiding theories of action, as noted by the dark orange bar. Below this value are the levels of agreement with the individual survey items that comprise this construct, denoted by the light orange bars. This figure shows that responses to individual items in this construct ranged from 63.5% to 85.7%. A more detailed description of the values for each construct summarized in Figure 7 is provided following this overview.

Figure 7 allows for comparison across implementation outcomes. For instance, relative to other implementation areas, coaching was the weakest outcome area and values/vision was an area of strength. Next, we provide a more detailed presentation of the survey items in each of these constructs, using data from educator interviews and open-ended survey responses to provide further insights and nuance.

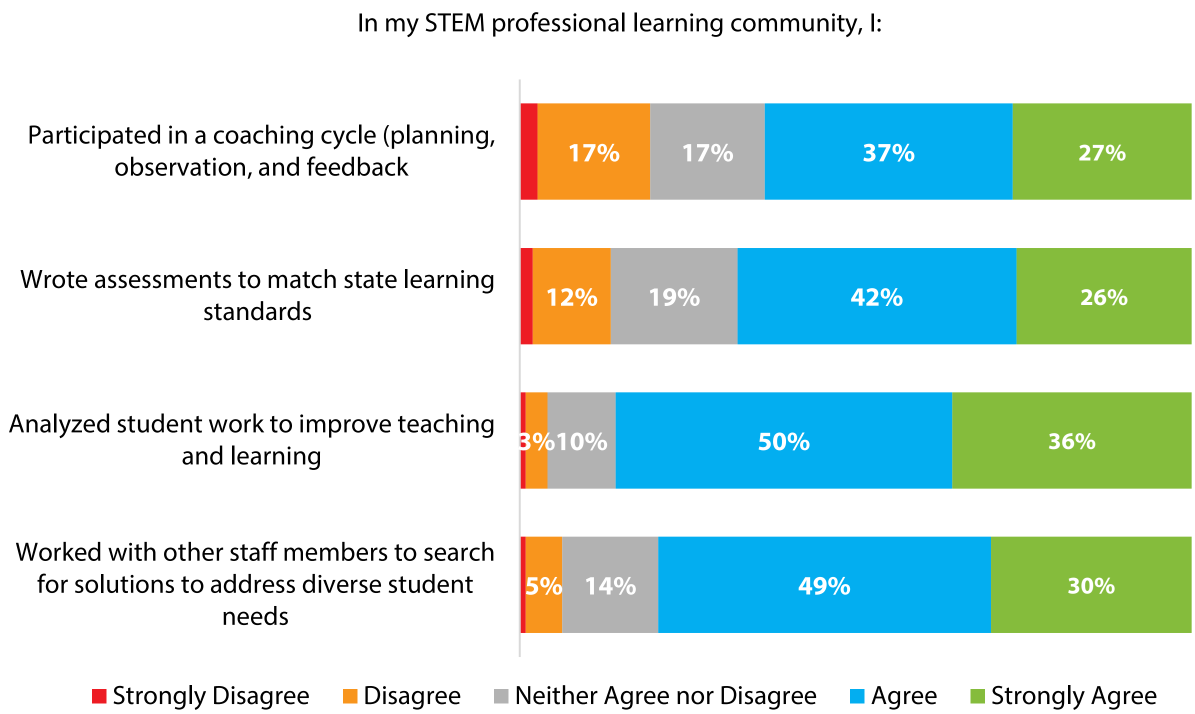
Figure 7. Rates of Agreement with Measures of Professional Learning Program Implementation



Program alignment with evidence-based collaborative practices was sometimes inconsistent

In the UEPC Educator STEM Professional Learning Survey, respondents were asked to rate their level of agreement with statements pertaining to the guiding theories of action of the Professional Learning Grant Program (Figure 8). The enactment of the Professional Learning Grant Program could occur by engaging in any of the four evidence-based collaborative practices listed in Figure 8. Agreement with these statements about the collaborative practices ranged from 64% to 86%. These levels of agreement were lower than many other measures in this survey. In particular, around one third of teachers reported that they did not participate in a coaching cycle or write assessments that align with state learning standards. Eighty percent or more of respondents indicated that their PLC analyzed student work to improve teaching and learning and worked with other staff members to search for solutions to address diverse student needs.

Figure 8. Educator Reports of Enacting Collaborative Practices



While about one quarter of survey respondents did report writing assessments to match state learning standards, several of the interviewees described their engagement with assessment writing and provided insights about how the process of integrating STEM standards into relevant and real-life assessments produced more interesting and applicable assessments for students. We provide the following interview response to illustrate the thinking that went into assessment-writing:

> *The assessment writing and integration of STEM content, that was one of the biggest challenges with teaching the new 3D science because we went from memorization to actually doing science. [So] rather than being super specific about you need to know this definition or whatever [when writing an assessment], the actually the doing of the science [was our focus], and that's a huge shift.*

With the assessment writing that we did, one of our main goals was to make the assessments relevant, something that [the students] would be able to connect with in their daily lives. The students were the ones that were doing science, not just memorizing a fact.

For example, we did an assessment where we set up a scenario where we told [the students] that they were going to their grandma's and looking at all of her old artifacts- old family history- they were trying to help grandma preserve this. And our standard that we were teaching was the difference between digital and analog waves. And [the students] had to, in the assessment, justify to grandma why she needed to digitize all of her artifacts, and then there's multiple reasons why.

And so it helped them realize that connection between, 'Oh, yeah. I can imagine myself going to grandma's and seeing all these old photos that are starting to turn funny colors and they really do need to be digitized to be preserved.'

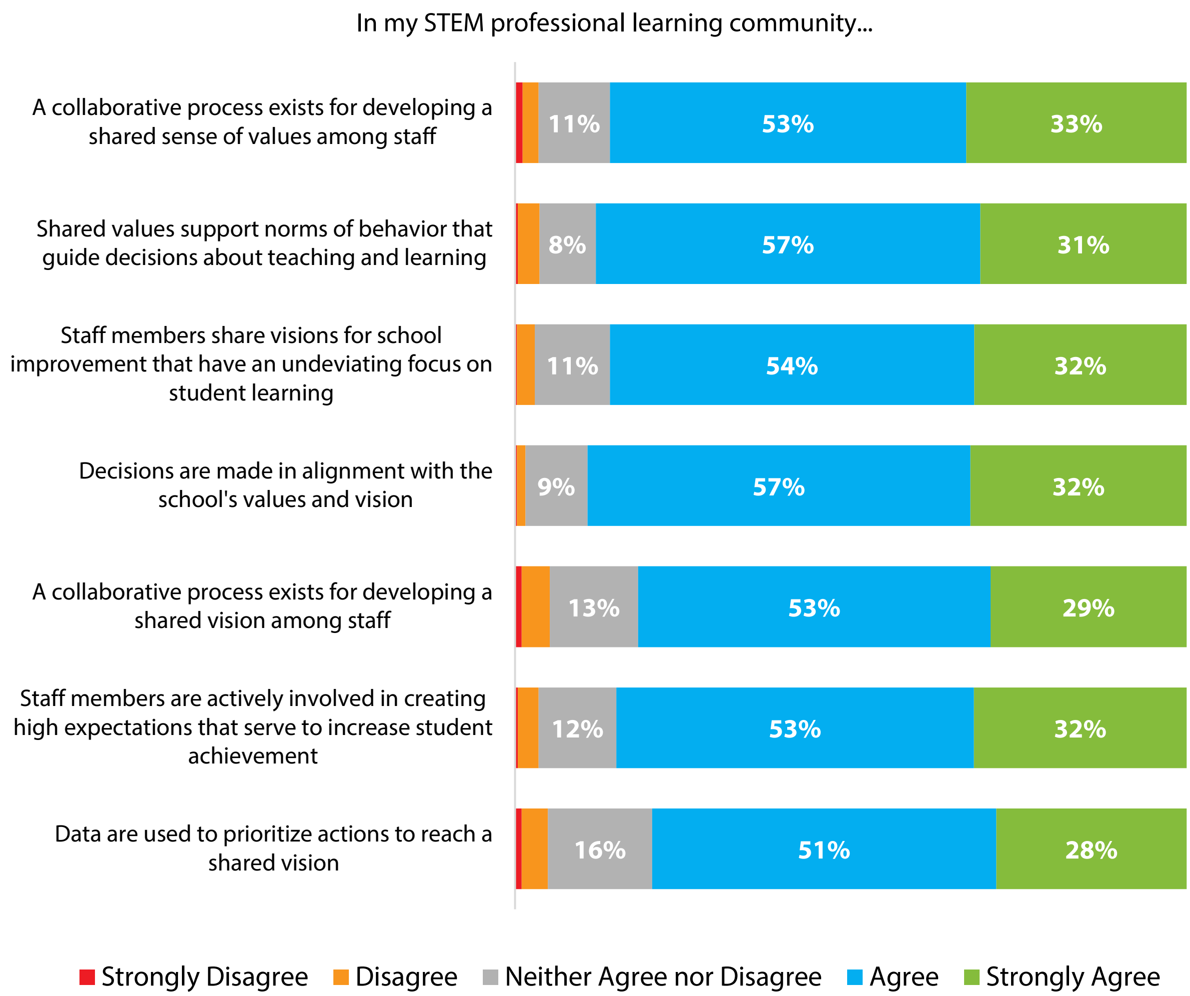
So we were able to increase their interest in what they were learning about when they could see a real-life application. And with that interest, comes the engagement. They were really into it. 'Oh, yeah. What would I say to grandma? How would I convince her?' … They were able to tie in what we were doing [in science class] to a real-life scenario.

Educators frequently reported efforts to work toward shared values and vision, but did not always use data to do so

"You're kind of saturated with tasks… So it's more that it creates kind of a shared goal, and a shared community effort, and it is at least recognized in a professional way by being paid for some of your time." (Educator interview)

When asked to rate their agreement with statements related to values and vision, levels of agreement were as high as 89% in some cases (Figure 9). Specifically, nearly nine in 10 educators agreed that decisions were made in alignment with the school's values and vision. In contrast, fewer individuals (79%) reported using data to prioritize actions to reach a shared vision.

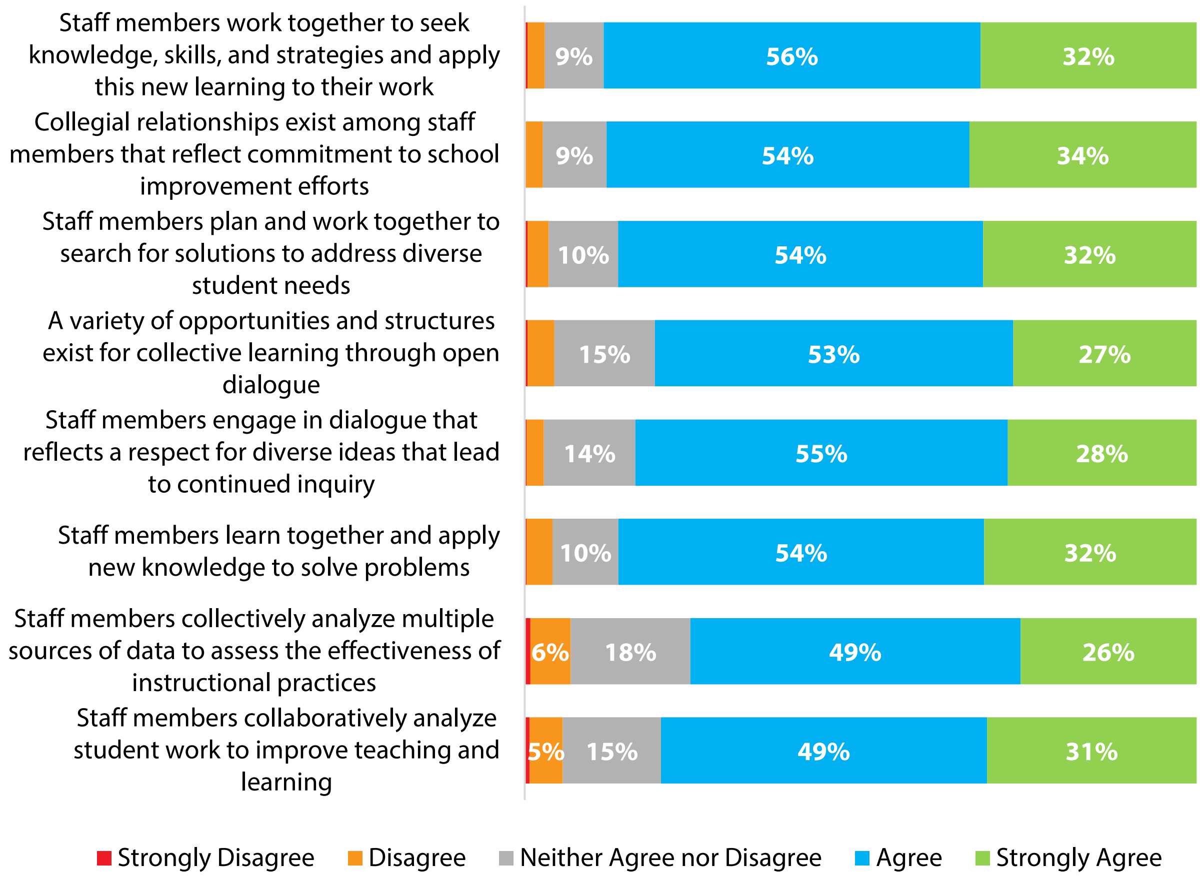
Figure 9. Educator Reports of the Alignment of Practices to Values and Vision



Educators reported strong relationships with colleagues within and across schools, but some struggled to use data and student work in their collaborations

Agreement with items measuring STEM collaboration ranged from 75% to 88%, as noted in Figure 10. Responses to these items suggest that participants had strong relationships with their colleagues. For example, 88% of respondents agreed that collegial relationships exist among staff members that reflect commitment to school improvement efforts.

Figure 10. Educator Reports of STEM Collaboration



Similarly, in open-ended survey responses, participants conveyed that collegial collaborations were beneficial and enjoyable, particularly when they had opportunities to develop relationships with educators from different schools:

- *I really enjoyed getting together with my peers to discuss ways to become better teachers. This was a nice respite from the craziness of this Covid year. Thank you for providing us with this opportunity. (Educator survey)*
- *It was so helpful!! I appreciate having a network of teachers in the district to work with to better integrate STEM into my classroom :) (Educator survey)*
- *I loved that the grant allowed for cohorts to meet that created relationships with teachers at different schools, thus supporting cross school collaboration. I feel I am a better teacher for my students when I have more peers to collaborate with and share my ideas. (Educator survey)*
- *I really liked how they were able to take teacher from around the state and gather them together virtually so we can learn from each other. I liked when they would do breakout sessions by grade. (Educator survey)*

- *I appreciate the time I was able to collaborate across schools in my area through this professional learning grant. It was beneficial to me. (Educator survey)*

- *One of my favorite parts was to collaborate with a group, which is very much part of STEM-working with groups and doing projects. (Educator interview)*

However, educators' ability to use data during these collaborations may be an area of needed growth. For example, one in four respondents did not agree that staff members collectively review multiple sources of data to assess the effectiveness of their instruction. Similarly, one in five respondents did not agree that staff members collectively analyze student work to improve teaching and learning. Open-ended survey responses supported the notion that educators faced challenges translating data into "actionable" steps they can take to enhance instruction:

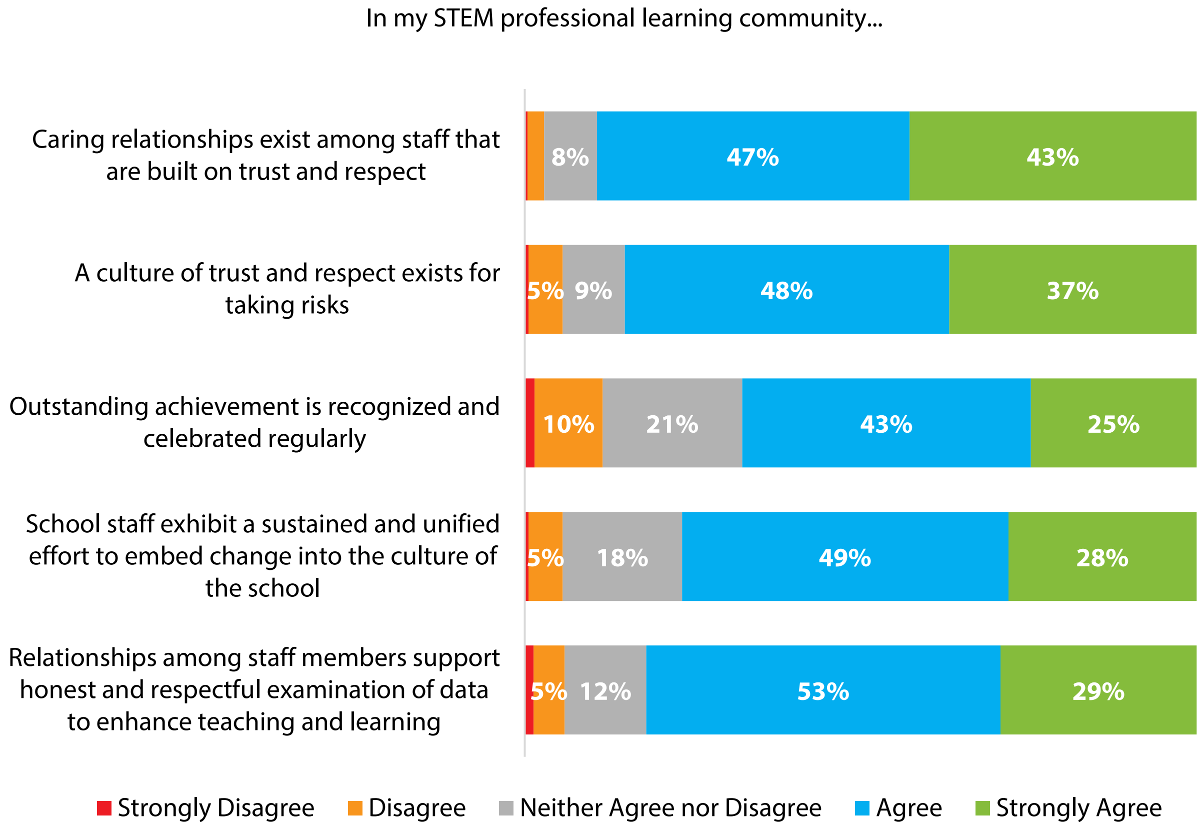
- *I love my job, but I struggle with collaboration. To me, there is a very large focus on collecting data, but very little training on how to turn the data into meaningful change or improvement. We have had some collaborative experiences in which we spend more than an hour looking at data, only to then leave without a single actionable response. (Educator survey)*

- *It's hard to learn how to use data to improve instruction. I'd like more information on that. (Educator survey)*

While educators generally reported strong relationships among staff, about one third did not agree that outstanding achievement was recognized and celebrated

Figure 11 summarizes educators' responses to survey items measuring relational conditions. Levels of agreement range from 68% to 90%. Nine in 10 respondents agreed that caring relationships exist among staff that are built on trust and respect, and 85% of participated agreed that their STEM professional learning communities had a culture of trust and respect for taking risks. Yet, only about two thirds of respondents agreed that outstanding achievement is recognized and celebrated.

Figure 11. Educator Reports of Relational Conditions

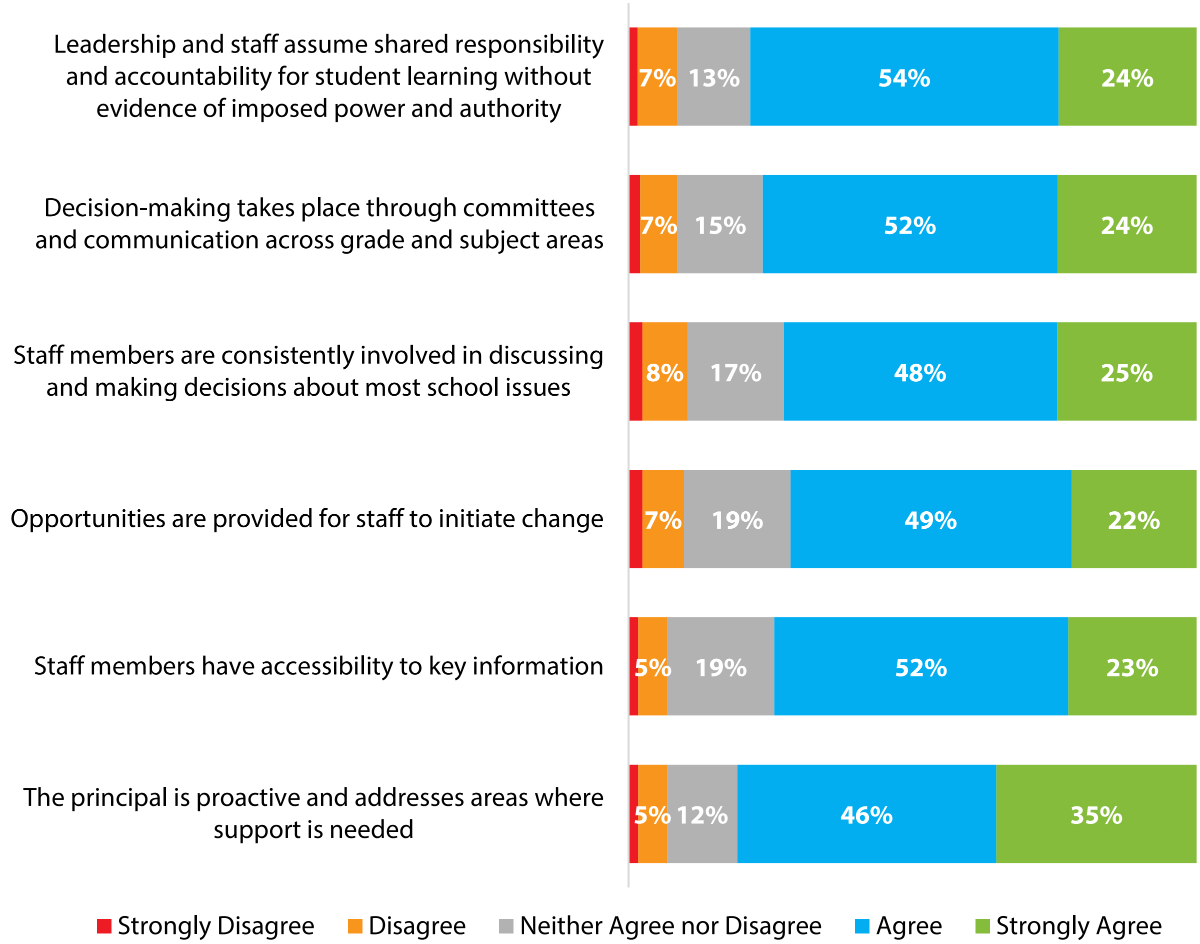


Educators commonly reported proactive administrators and shared responsibility, but did not always feel they had the ability to initiate change

"District admin and occasionally the leadership at my school… are not interested in my opinion or input." (Educator survey)

As shown in Figure 12, approximately three in four respondents agreed with statements about leadership involvement in professional learning. Levels of agreement ranged from 71% to 81%. The highest levels of agreement were with statements pertaining to shared responsibility (78%) and the principal's ability to be proactive (81%).

Figure 12. Educator Reports of Leadership Involvement



In their open-ended survey responses, educators largely conveyed similar positive sentiments about leadership involvement in professional learning:

- *I really appreciate the science leaders in [my district]. I often feel like people in the district don't do anything to support the teachers but I can honestly say that the science leaders are giving 100%. They have worked hard to create great resources (SO appreciated!) and they have tried to make the professional development beneficial and useful. They've tried to give us practical ideas for incorporating STEM into our classrooms and are always available for support. I really appreciate them and I've been impressed with their efforts. (Educator survey)*

- *The professional development I have received this year through our district science specialist has been outstanding and among the most useful and productive training classes I have attended. (Educator survey)*

- *I just want to mention that our district has provided us with great STEM lessons. Our district science specialist has been the one creating the lessons for us this year. I am looking forward to next year when I have a better understanding of the standards and can incorporate my ideas with those from the district. (Educator survey)*

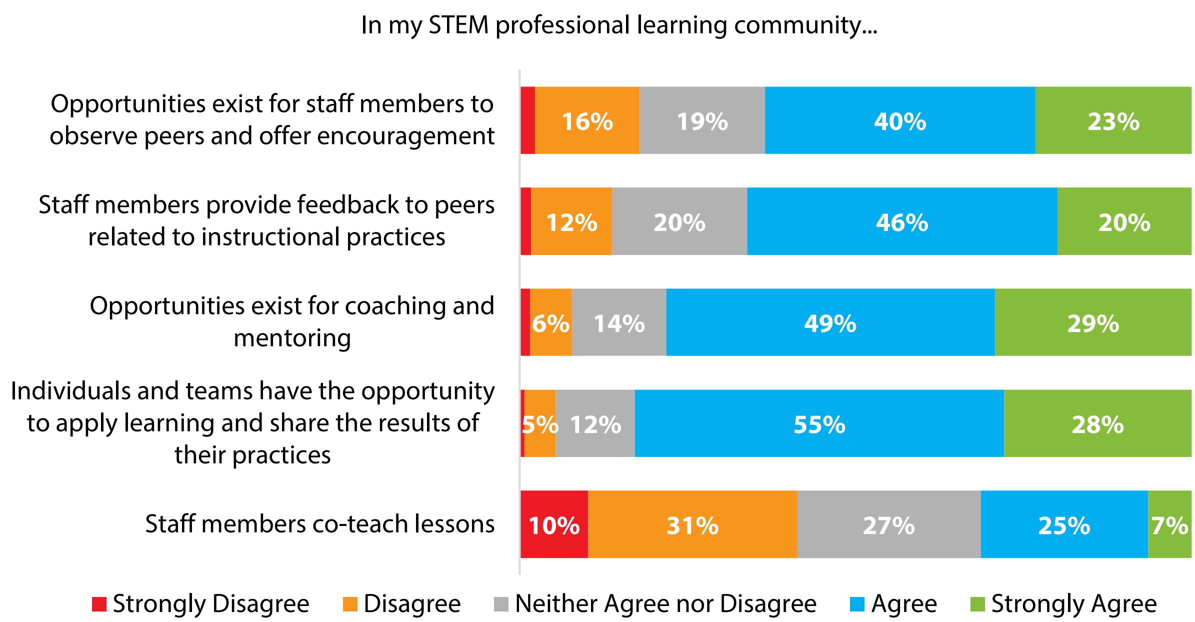
However, fewer respondents agreed that there were opportunities for staff members to initiate change (71%) and participate in decision-making about school issues (73%). One educator commented: "District admin and occasionally the leadership at my school…are not interested in my opinion or input." While leaders' support and involvement in professional learning was prevalent, Educators had fewer opportunities to initiate changes in their professional learning communities.

Coaching opportunities varied substantially

"I would love to observe experienced teachers in this area to help improve my own teaching!" (Educator survey)

According to educator survey data summarized in Figure 13, coaching opportunities varied substantially. Agreement with survey items about observation, coaching, mentoring, and co-teaching ranged from 32% to 83%. On the lower end, only about one third of participants agreed that staff members co-taught lessons together and only about two thirds of respondents agreed that opportunities for peer observation existed. More commonly, however, many respondents (83%) agreed that the opportunity exists to apply what they are learning and share the results of their practice. While educators shared what they were doing throughout the year, they had fewer opportunities to observe others' practice.

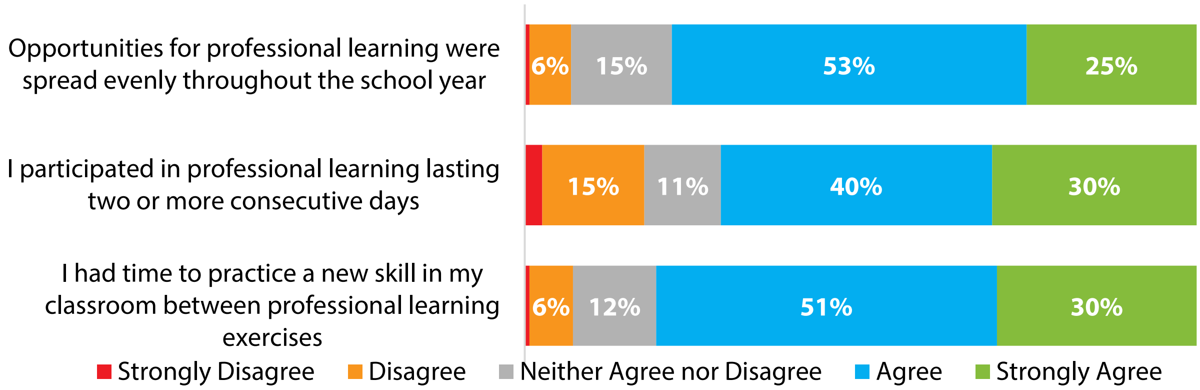
Figure 13. Educator Reports of Opportunities Related to Coaching, Peer Observation and Feedback, and Co-teaching



Professional learning varied in consistency, duration, and design across contexts

As shown in Figure 14, nearly one third of participants did not participate in professional learning that lasted two or more consecutive days, and only 78% of respondents agreed that professional learning was spready evenly throughout the year. About four in five respondents agreed they had time to practice new skills between professional learning exercises, while the remaining 20% did not.

Figure 14. Educator Reports of Consistency and Duration of Professional Learning



According to interview participants, the implementation of the Professional Learning Grant Program varied based on each unique project and context. Summer trainings provided foundational learning and coaching from trainers, then collaborative partnerships were formed and enacted in multiple ways. Several participants offered descriptions of how professional learning was implemented in different contexts, including within- and across-school collaboration, and with various learning goals related to strengthening curriculum and instruction:

- *The eighth-grade teachers in the district worked together to build the [STEM] curriculum, especially the curriculum that went online.... The scope and sequence was already made from the district, so we had to use that scope and sequence and fill [in] what should be included in each module. Each module was a week and the module should contain an overview page and a pre-test, a reading activity, math, a post-test and an overview summary page, and a looking ahead page. Each week we wanted to include some sort of engineering or math…technology was always there because they were on their computers. (Educator interview)*

- *We met way back in October, formulated partners or groups, and then [partners or groups] talked back and forth through Swivel. So, it was elementary school teachers working with high school teachers, which was fun to see, because then we could give feedback with the different grade levels that we taught. (Educator interview)*

- *Each time we met was a check-in point more than a meeting, very functional, not a waste of our time… it was, 'What questions do we have? What do we need to do? Who needs to do it? When do we need to have it done by?' and then, 'Let's go do it' -short and sweet. Then we would leave feedback for each other. Then our district leader had a couple of Fridays throughout the year where we would meet together as an entire middle school Zoom conference…They would share feedback with us, and we would share feedback with them and say what was coming up. Sometimes it was logistical, 'This doesn't work,' or, 'How is this supposed to work?... there was sharing of ideas, 'How can I put math into this? How can I use a phenomenon in this? How can I integrate this into this?' (Educator interview)*

Most educators received suggestions and resources they could immediately apply to their work

Agreement with statements related to the extent to which professional learning reflected adults learning principles (Figure 15) ranged from 72% to 87%. At one end of the spectrum, 72% of individuals felt they had been given the opportunity to participate in the creation of content and 73% agreed that material was introduced gradually so as to allow time to assimilate new learning. In an open-ended survey response, one educator suggested that assimilation would be improved with time between professional learning sessions, similar to the structure of the summer trainings: "One of the thoughts I have is allowing teachers to use a product or practice a way of teaching after the training, and then have another training/meeting. The second time we meet we are more familiar with the content and know more questions to ask. I felt the training in the summer was done well and spread out enough that we could continue to learn each time we met."

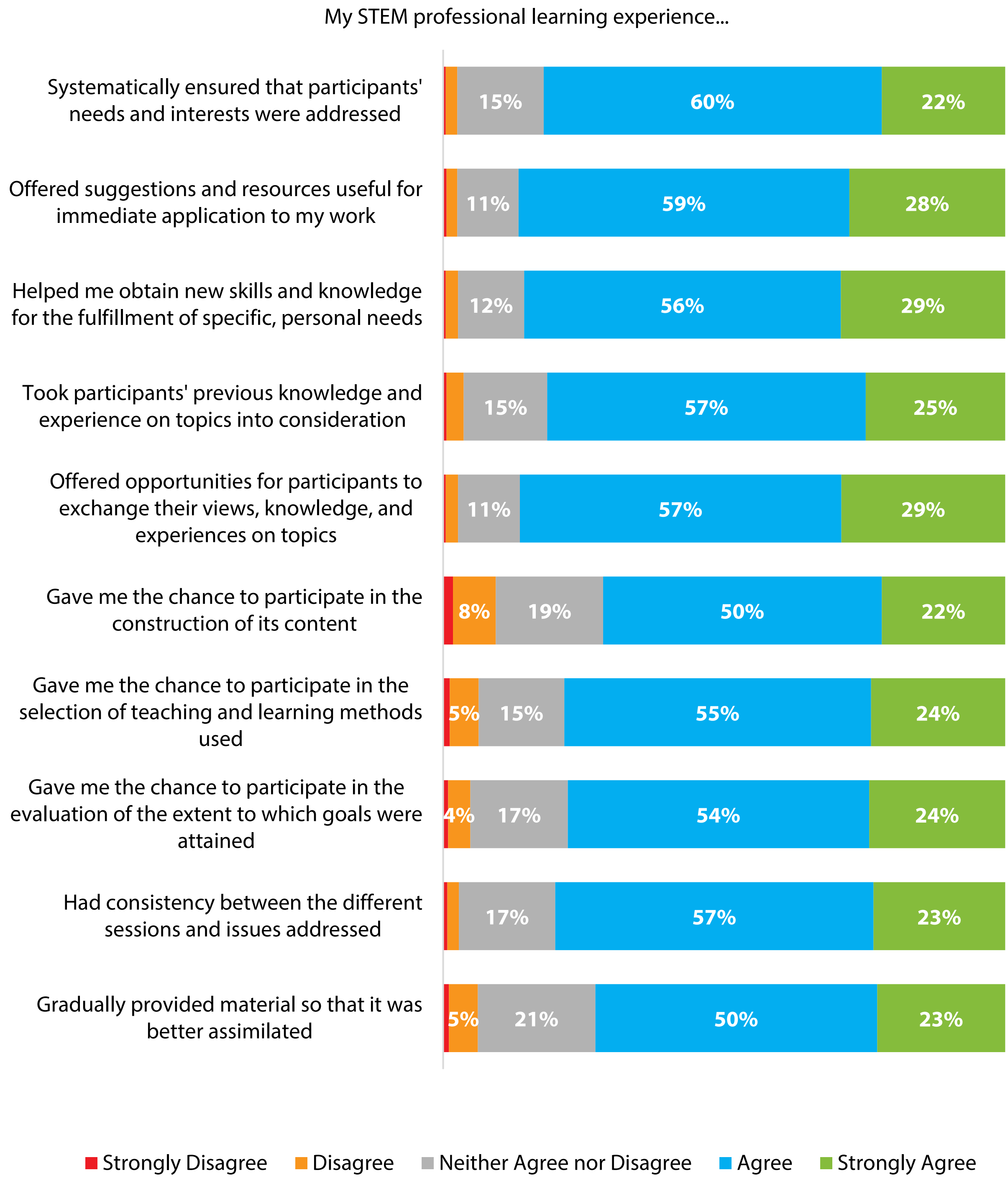
Overall, most respondents (87%) felt they received suggestions and resources that they could immediately apply to their work. Similarly, educators expressed in open-ended survey responses that the suggestions and resources they received during their professional learning experience were beneficial and relevant:

- *I have appreciated all the resources and classes that my district and state have provided. (Educator survey)*

- *The STEM professional learning at my school has been implemented in a way that provides me with the skills I need to adapt to changing digital and in person teaching methods. It has better prepared to meet student needs during an unpredictable year. It has giving me the time and resources to stay on top of an ever-changing learning environment. (Educator survey)*

- *I appreciate a STEM PD that is tailored to specific grade level standards and all necessary materials are provided. Making it applicable and implementable really creates a passion and excitement to teach it! (Educator survey)*

Figure 15. Educator Reports of the Extent to Which Professional Learning Adhered to Adult Learning Principles



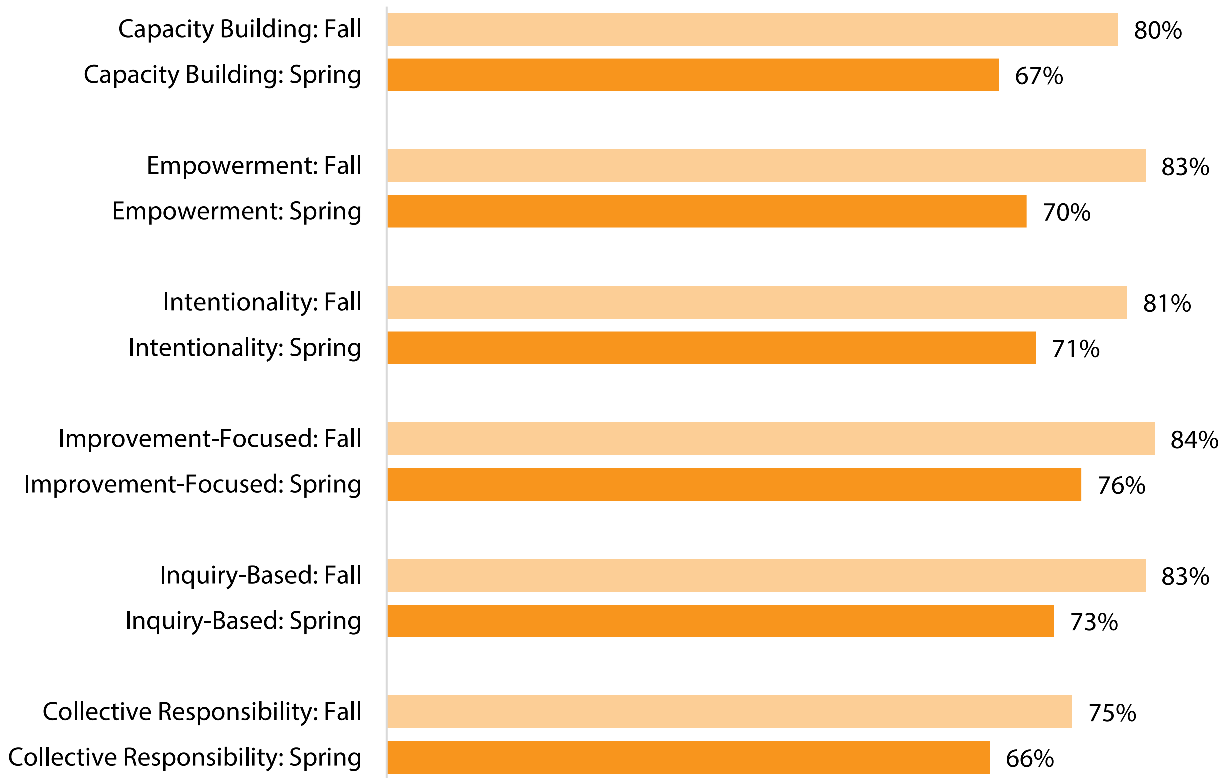
As the COVID-19 pandemic impacted schools, self-reported levels of educator collaboration declined substantially during the 2020-21 school year and varied by district/school

Educators participating in the Professional Learning Grant program reported on collaboration practices in their professional learning communities during the fall and spring of the 2020-21 school year. Collaboration was measured across six dimensions – capacity building, empowerment, intentionality, improvement-focused, inquiry-based, and collective responsibility.

There are several important caveats to the data presented in this section. During 2020-21, schools throughout Utah were impacted by COVID-19. Next, as noted in the methods section, of the 26 unique districts with at least one participant represented in this survey, only 14 districts had participants during both the fall and spring administrations of the survey, while the other 12 only participated in either fall or spring. Furthermore, only five districts had at least 10 respondents at both points in time. Initially, there was no intent to be able to match respondents to districts/schools. However, the utility of the results to inform program implementation and support resulted in the decision to administer the survey with an ability to report for the individual site. Because the fall administration of the instrument was anonymous, we are unable to match respondents between the fall and spring administrations. While individual districts' and schools' results were made available to the STEM Action Center personnel and appropriate district personnel via a secure data dashboard, this report contains an aggregate level analysis of these data. For more details about the administration of this survey and response rates, please see the methods section of this report.

As illustrated in Figure 16, self-reports of collaboration across all six domains declined between fall and spring of the 2020-21 school year. Each value in this figure represents the percentage of "moderately" and "extremely" responses, the two highest categories on a five-point Likert-style scale. Each of the six domains in this figure is a composite measure of 7-10 survey items. For example, 80% of fall responses pertaining to capacity building were either "moderately" or "extremely." In spring, only 67% of responses were one of these two categories. We observed similar patterns across the remaining domains of collaboration. In all cases, responses dropped at least eight percentage points. We conducted a two-sample t-test of these results to determine the statistical significance of these decreases, and in all cases, they were found to be statistically significant ($p<.05$). This means that differences in collaboration levels between the fall and spring were not due to chance, but rather they reflect actual changes in collaboration across the entire population of participants.

Figure 16. Educators' Collaboration Self-Assessment Results in Fall and Spring of the 2020-21 School Year



These findings may be driven by more intense professional learning completed by participating educators in the summer prior to the beginning of the school year and near to the time educators completed the fall survey. The STEM Action Center's website[3] notes that educators often engage in work over the summer to prepare for the following school year. As described by a participant: "I felt the training in the summer was done well and spread out enough that we could continue to learn each time we met." Because of this, educators may have reported greater collaboration earlier in the year when they had more recently engaged in this intensive summer work. Moreover, we note that nine of 14 districts with data collected at both points in time did report some increase in collaboration. This suggests that these results may be driven, in part, by districts that only participated in the survey at one point in time (i.e., either fall or spring, but not both).

Furthermore, the nature of and potential for both professional learning/trainings and peer collaborations in the 2020-21 school year were affected by the COVID-19 pandemic. While some districts had in-person professional learning earlier in the school year, virtual formats were more common later in the year. It may be the case that this shift contributed to lower perceptions of collaboration. As one educator noted in an interview, "If I'm real with you… I didn't like being on the computer all the time." The following quotations provide further insights into how educators felt about the school year more broadly as they tried to implement innovative ideas with their PLC:

- *This year has been especially challenging for STEM professional learning experiences. Doing on-line/Zoom trainings test the patience in even the best of us and isn't very productive. I am looking*

[3] https://stem.utah.gov/educators/opportunities/professional-learning-grant/

forward to a more interactive environment for my own learning and development during this upcoming year. (Educator survey)

- *I am excited for next year. I'm exciting to implement some of these things. I'm hoping, through a couple of conferences that I have to go to this summer, that I can rebuild some of that confidence back, because this last year, as awesome as that PLC was, and all of those awesome ideas that we had, it was a very hard year as far as my confidence and satisfaction with what was happening with my kids. I felt I was drowning a lot this last year, and I was really worried about my kids because they were really struggling, too. It was hard. (Educator interview)*

- *COVID put a huge switch in the momentum we had with our new SEEd standards for Utah. We were quickly made as online teachers and working on Google Docs and CANVAS platforms that were new…I gave it my best shot this year but will need the TIME in class and the materials to make more Hands-on learning happen for my students. (Educator survey)*

These challenges likely influenced educators' self-reported levels of collaboration. The effects of the pandemic are discussed in greater detail in the section titled *STEM Educator and Student Outcomes.*

We also found substantial variation in collaboration rates across districts. As illustrated in Table 5, some districts did not have any educators who provided a response of "moderately" or "extremely" (i.e., capacity building, improvement-focused, inquiry-based, and collective responsibility in the spring), while 100% of responses in other districts were "moderately" or "extremely" (e.g., empowerment in the fall, capacity building in the spring). This demonstrates the substantial variation in collaboration rates across districts/schools.

Table 5. Variation in Collaboration Self-Assessment Results across Districts

Collaboration Domain	**Fall**		**Spring**	
	Min	Max	Min	Max
Capacity Building	43%	98%	0%	100%
Empowerment	67%	100%	17%	100%
Intentionality	50%	100%	5%	93%
Improvement-Focused	70%	100%	0%	100%
Inquiry-Based	52%	100%	0%	100%
Collective Responsibility	50%	98%	0%	88%

Note: Percentages represent the proportion of "moderately" (4) and "extremely" (5) responses on a five-point scale.

In our interpretation of these findings, we again acknowledge the limitations noted above. While we were unable to track specific participants over time, we know that almost half of participating districts were only represented in the data at one point in time. As such, these substantial declines in reported collaboration may not necessarily represent true decline in collaboration across all participating districts and schools.

STEM Educator and Student Outcomes

To evaluate the extent to which the STEM Action Center's Professional Learning Grant Program was associated with positive educator and student outcomes, we analyzed data from the UEPC Educator STEM Professional Learning Survey, the UEPC Student STEM Survey, and interview data to explore educator outcomes in the areas of efficacy, confidence, knowledge, identity, skills and application of skills, collaboration, and planning and integration of STEM content as well as student outcomes in the areas of STEM interest, engagement, confidence, identity, and achievement . We also considered how participation in the Professional Learning Grant Program was associated with instructional time devoted to STEM.

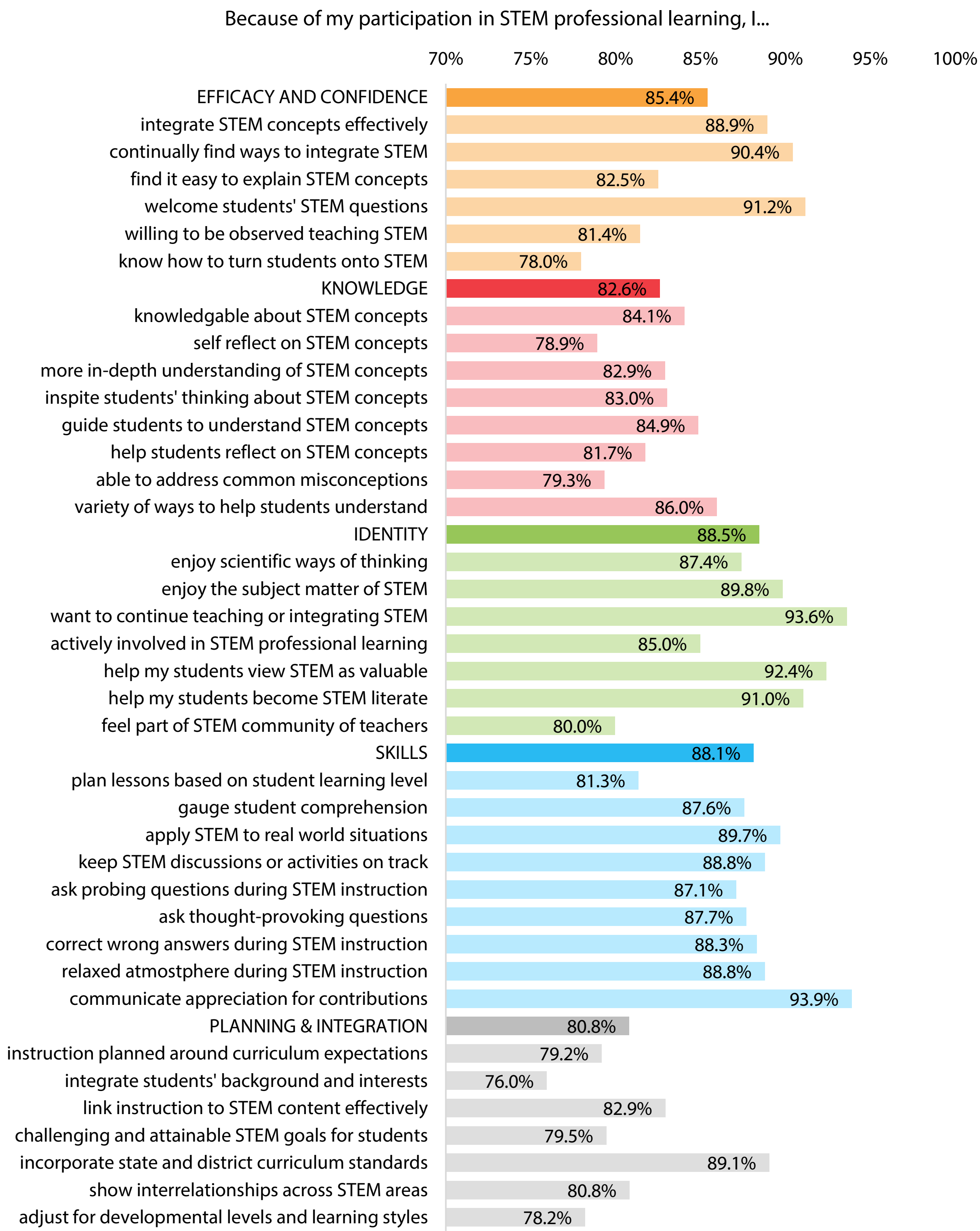
How effective is STEM Professional Learning in increasing teacher outcomes in efficacy, confidence, STEM knowledge, STEM identity, skills and application of skills, collaboration, and planning and integration of STEM content?

Overall, educators generally reported positive perceptions of their own STEM attitudes and skills

UEPC Educator STEM Professional Learning Survey participants responded to various items measuring their perceptions of their own STEM attitudes and skills. We begin our discussion of survey results with a high-level overview of educators' perceptions of efficacy and confidence, knowledge, identity, skills, and planning and integration in STEM (Figure 17). Each percentage in this figure represents the percentage of "agree" and "strongly agree" responses submitted by educators. For example, 85.4% of respondents agreed with items measuring efficacy and confidence as noted by the dark orange bar. Below this value are the levels of agreement with the individual survey items that comprise this construct, denoted by the light orange bars. This figure shows that responses to individual items in this construct ranged from 78.0% to 91.2%. A subsection devoted to each subconstruct in Figure 17 provides addition details about the findings.

Figure 17 allows for comparison across outcomes: STEM planning and integration was a slightly weaker educator outcome in this set, while STEM identity and STEM skills were areas of strength. Collectively, these results suggest that although educators had strong perceptions of their skills and identity in STEM, there may be room for further growth in their ability to plan and integrate STEM content. Next, we provide a more detailed presentation of the survey items in each of these constructs.

Figure 17. Rates of Agreement with STEM Self-Reported Educator Outcomes

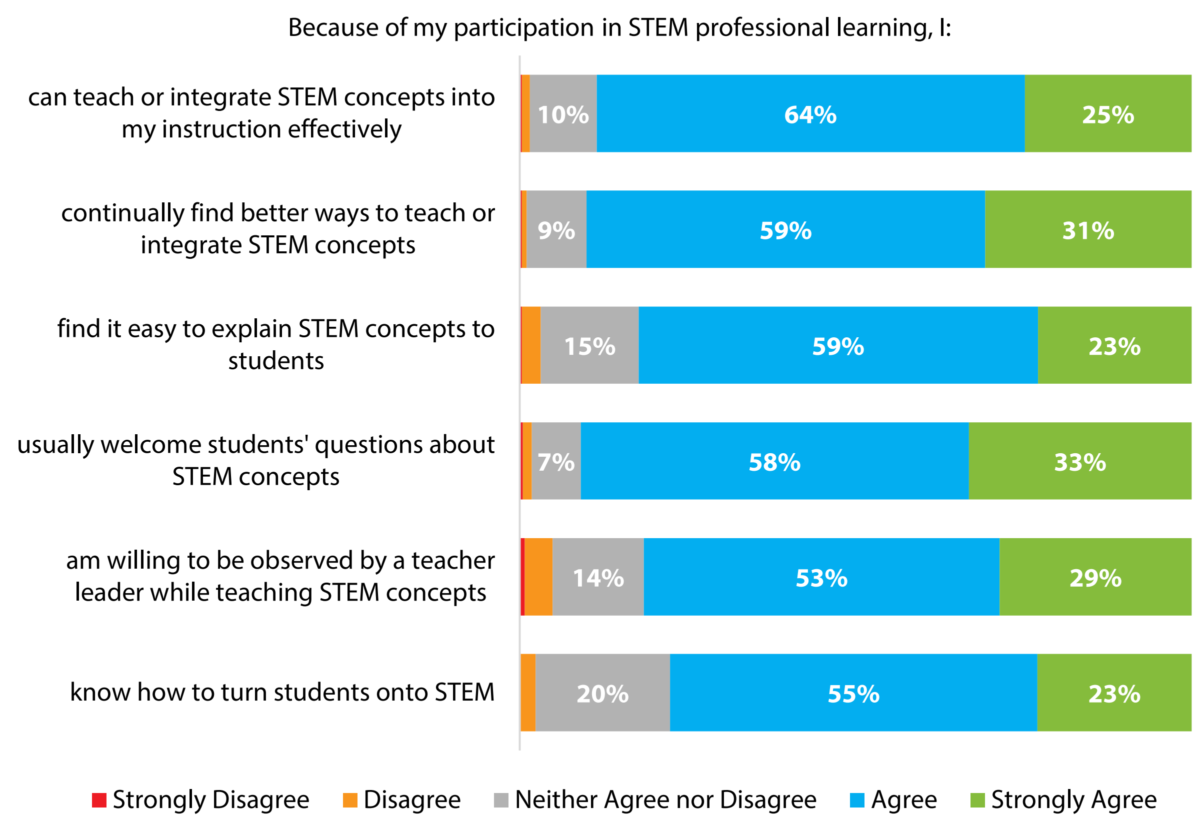


Educators reported high levels of STEM efficacy and confidence, particularly with answering students' questions about STEM concepts

> "The confidence of being able to transition into these [STEM] subject areas with some degree of real knowledge and expertise is something that's definitely been built." (Educator interview)

Figure 18 contains a summary of educators' responses to items about STEM efficacy and confidence. Participants reported high levels of agreement, ranging from 78% to 91%, with survey items in this construct. The highest levels of agreement were found when educators were asked about their willingness to answer students' questions about STEM concepts. Only 9% of respondents indicated a neutral or negative response to this item. In contrast, the lowest levels of agreement were found when educators were asked about their ability to get their students excited about STEM. For this particular item, 22% of respondents indicated a neutral or negative response. Survey results also indicated that educators felt confident about their ability to teach or integrate STEM concepts into their instruction effectively (89% in agreement), continually found better ways to teach or integrate STEM concepts (90% in agreement), and found it easy to explain STEM concepts to students (82% in agreement).

Figure 18. Educator Reports of STEM Efficacy and Confidence

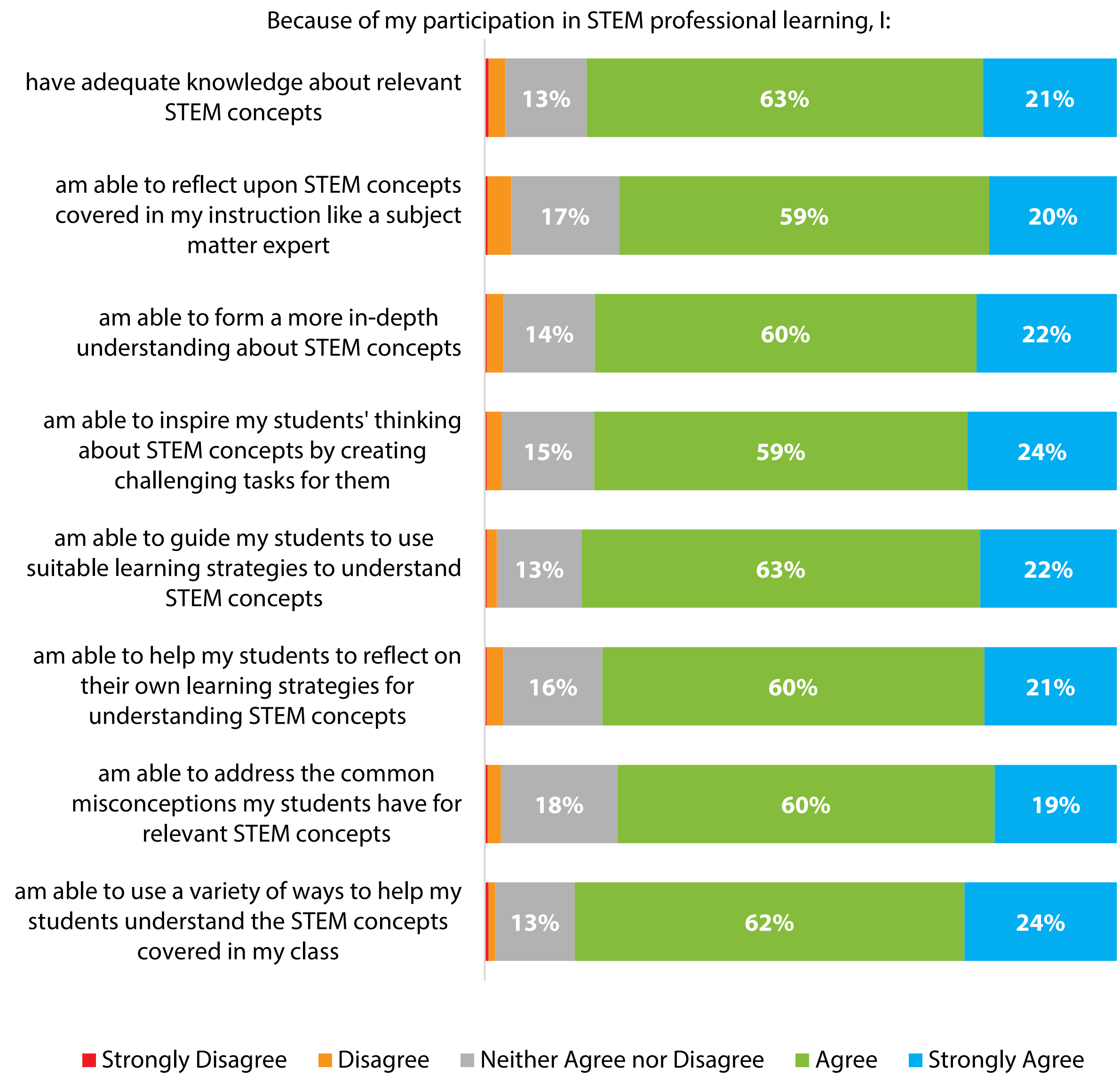


Educators reported high levels of STEM knowledge, noting that they could use a variety of approaches to help students understand STEM

> "My knowledge has increased. I've had to do a lot of research to make sure that the curriculum not only met science standards, which I have now become very familiar with and didn't know before…" (Educator interview)

As shown in Figure 19, most educators reported high levels of agreement with items measuring STEM knowledge. Levels of agreement (defined as selecting "agree" or "strongly agree") ranged from 79% to 86%. Educators were most likely to agree that they could use a variety of approaches to help students understand STEM topics (86%), and least likely to agree that they could reflect on STEM topics like a subject matter expert and address common misconceptions that students have about STEM (79%).

Figure 19. Educator Reports of STEM Knowledge

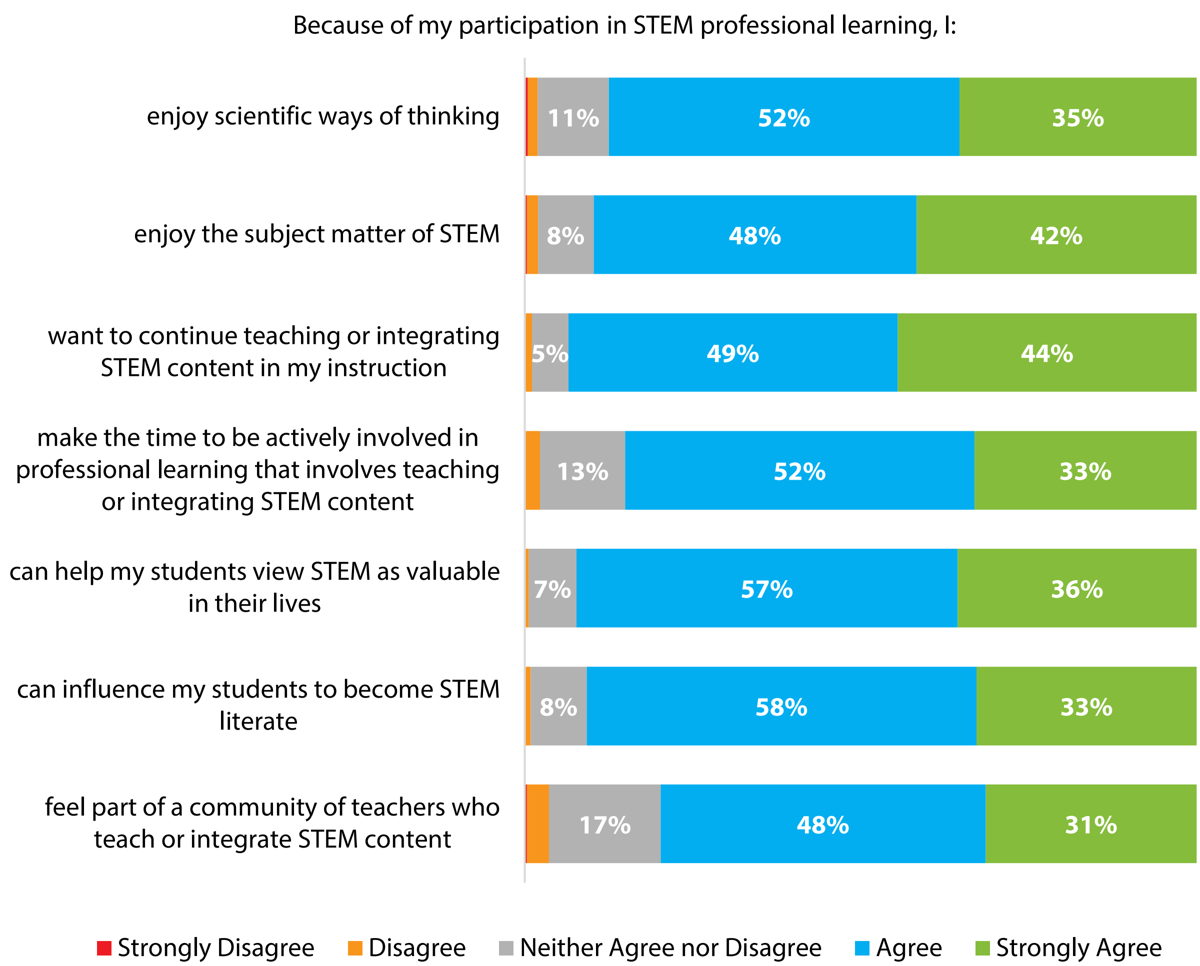


Educators generally reported strong STEM identities and influence on students, though one in five respondents did not feel they belonged to a community of teachers who teach or integrate STEM content

Levels of agreement with statements measuring STEM identity ranged from 79% to 93%, as illustrated in Figure 20. At the lowest end of this range, 21% of respondents did not agree that they felt like they belonged to a community of teachers who teach and integrate STEM content. At the other end of the spectrum, nearly all (93%) of respondents agreed that they want to continue teaching and integrating STEM content into their instruction. This commitment to STEM instruction may be related to educators' strong personal enjoyment of the subject matter (90% in agreement) and the sense that they are able to influence their students to view STEM as valuable (93% in agreement) and become STEM literate (91% agreement).

> "For me, one of the biggest things was identifying as a STEM educator. Although I identified in many other ways as an educator, I never thought of myself as a STEM educator at all because I do not teach the sciences…and I don't have in-depth knowledge like a science teacher would. But I now do identify as a STEM educator because I have so many STEM PBLs going along." (Educator interview)

Figure 20. Educator Reports of STEM Identity

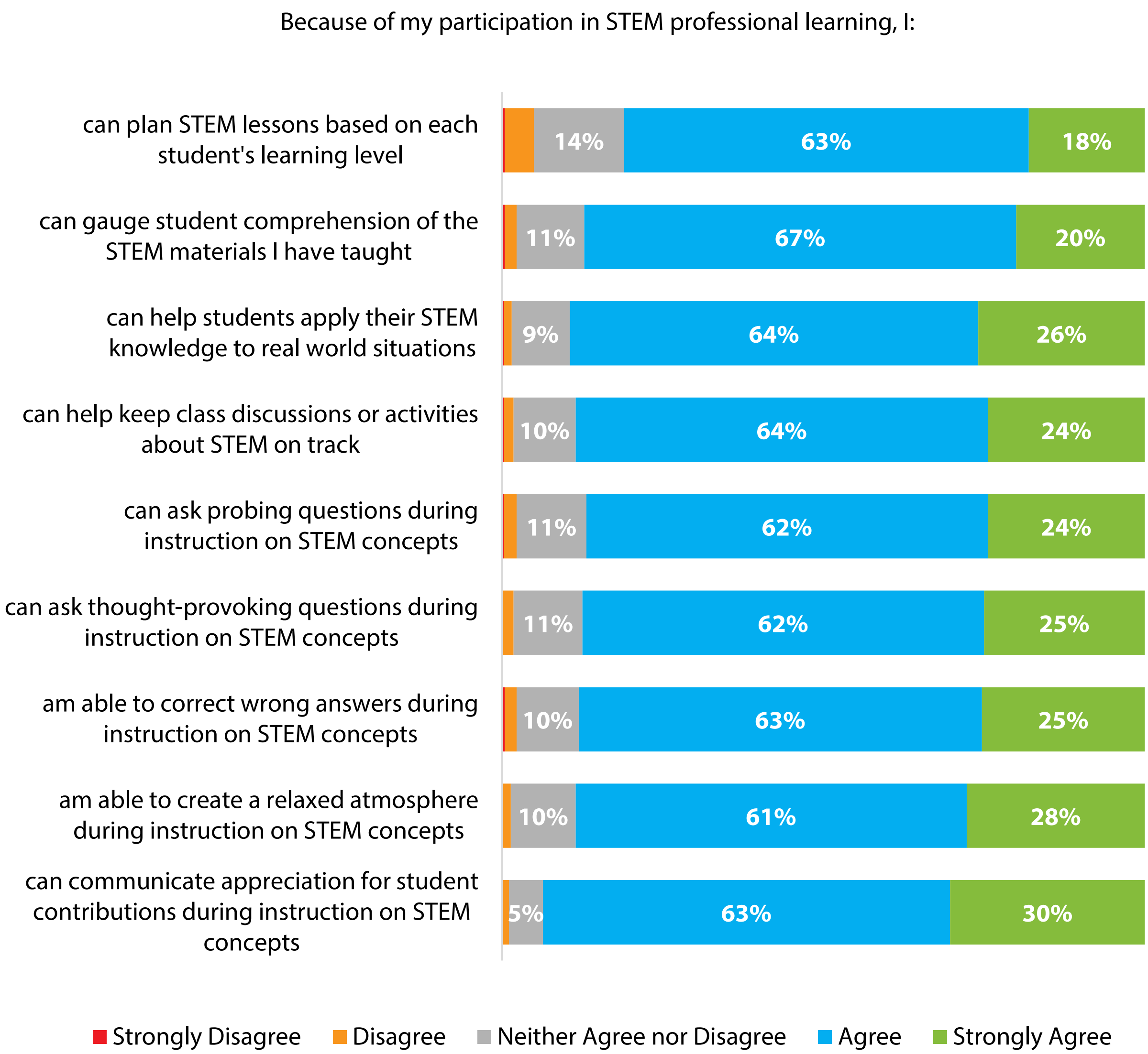


Self-reported STEM instructional practices were generally high among educators, while opportunities exist to better differentiate instruction based on student learning levels

> "I would say that my instructional skills have also increased…because of the videos we've had to produce and watch. I mean, when you watch yourself teaching, it's a shock, to say the least." (Educator interview)

As shown in Figure 21, educators responded to a set of survey items about their perceived STEM instructional practices and student interactions. Levels of agreement with these items ranged from 83% to 91%. Notably, the item with the lowest levels of agreement measured educators' self-reported abilities to plan STEM lessons based on each student's learning level. Nearly one in five participants did not feel they were able to differentiate STEM instruction to meet all of their students' needs (i.e., *I can plan STEM lessons based on each student's learning level* in Figure 21). In contrast, most educators (91%) agreed that they could communicate appreciation to students for their contributions during STEM instruction. Levels of agreement with other items in this construct fell somewhere between these two examples. For instance, 88% of educators agreed that they were able to correct wrong answers during instruction on STEM concepts and keep class discussions or activities about STEM on track. When asked if they could create a relaxed atmosphere during instruction on STEM concepts, 89% of educators agreed. Nine in ten (90%) of respondents agreed that they help students apply their STEM knowledge to real world situations.

Figure 21. Educator Reports of STEM Instructional Practices and Student Interactions



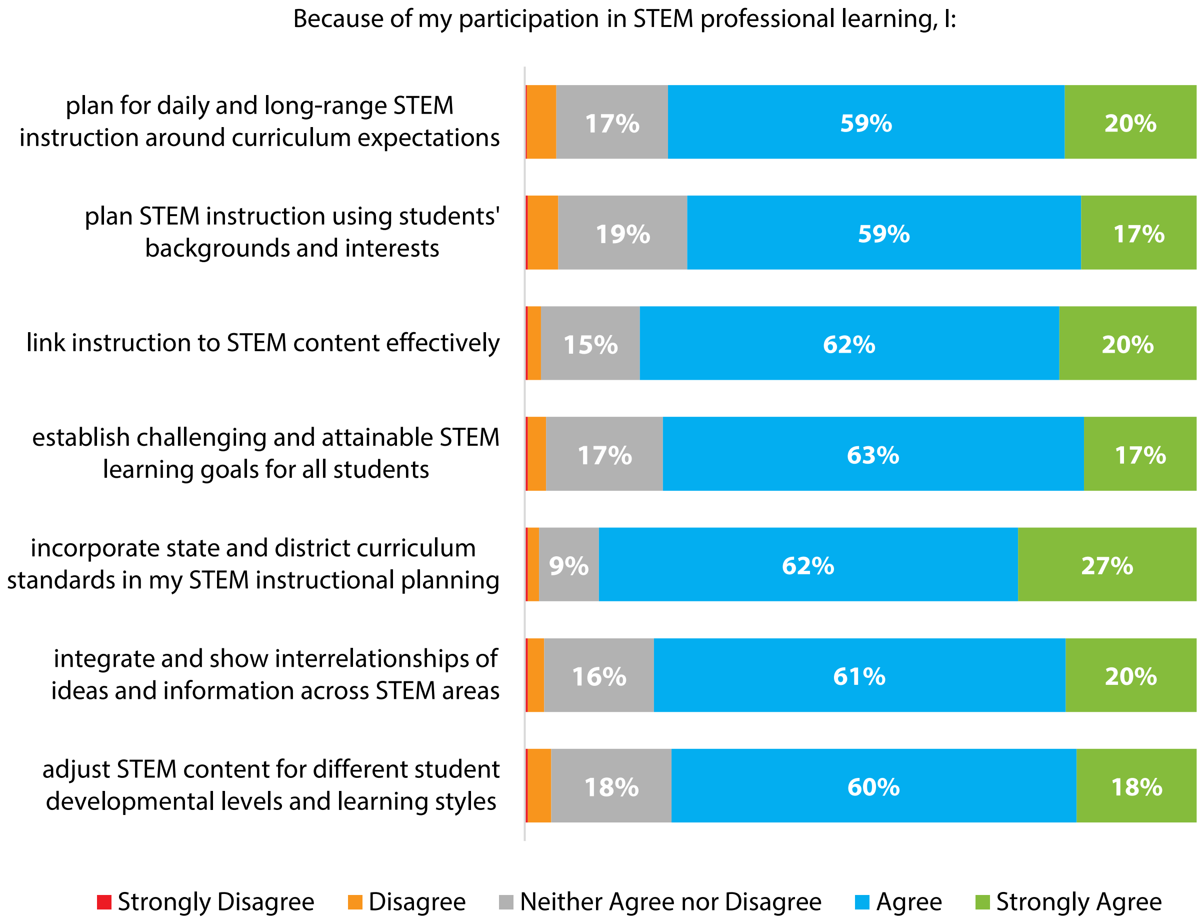
Educators reported success in STEM instructional planning and integration, but struggled to adjust content to meet individual students' learning needs

> "I enjoy learning new STEM concepts and integrating them into my music lessons… The knowledge I receive in professional learning is vital to this integration." (Educator survey)

When compared to the previous four constructs, educators' perceived abilities to plan and integrate STEM content was lower. Figure 22 shows that levels of agreement with these survey items ranged from 76% to 89%. Mirroring our previous set of results, we found that approximately one in four educators struggled to plan STEM instruction using students' backgrounds and interests. Educators also reported lower levels of agreement with their ability to plan for daily and long-range STEM instruction around curriculum expectations (79% in agreement), adjust STEM content for different student developmental levels and learning styles (78% in agreement), and establish challenging and attainable STEM learning goals for all students (80% in agreement). At the other end of the spectrum, 89% of educators reported success in incorporating state and district curriculum standards into their STEM instructional planning.

As one survey respondent explained: “It has been very helpful to see how the new standards can be implemented to help the students learn and have a more concrete understanding.”

Figure 22. Educator Reports of STEM Planning and Integration of STEM Content



Educators who participated in video-based self- and peer-reflection had more positive attitudes about STEM

> “I like the STEM videos. It helps me to see my strengths and weaknesses. I also like the opportunity to see how other teachers teach and get STEM ideas from them.” (Educator survey)

Respondents to the UEPC Educator STEM Professional Learning Survey were asked to report whether they engaged in video-based self- and peer-reflection. Approximately 75% of respondents reported engaging in video-based self-reflection and 46% engaged in peer-reflection. We compared outcomes in the areas of confidence/efficacy, knowledge, identity, STEM instructional practices and student interactions, and planning and integration of STEM content among those who did and did not engage in these forms of video-based reflection. Each of the measures shown in Figure 23 and Figure 24 correspond with the outcomes depicted in Figures 17-22. Results in Figure 23 and Figure 24 show that STEM outcomes were higher among educators who reported engaging in video-based reflected compared to those who did not. For example, the average level of agreement with survey items measuring confidence and efficacy was 86.6% among the 75% of educators who participated in video-based self-reflection and 76.2% among the 25% who did not. Similar differences were found across other outcomes for both self-reflection and peer-reflection. While these findings are not necessarily causal, we do find a positive correlation between video-based reflection and self-reported STEM outcomes for educators.

Figure 23. Comparison of Educator Outcomes by Engagement in Video-Based Self-Reflection

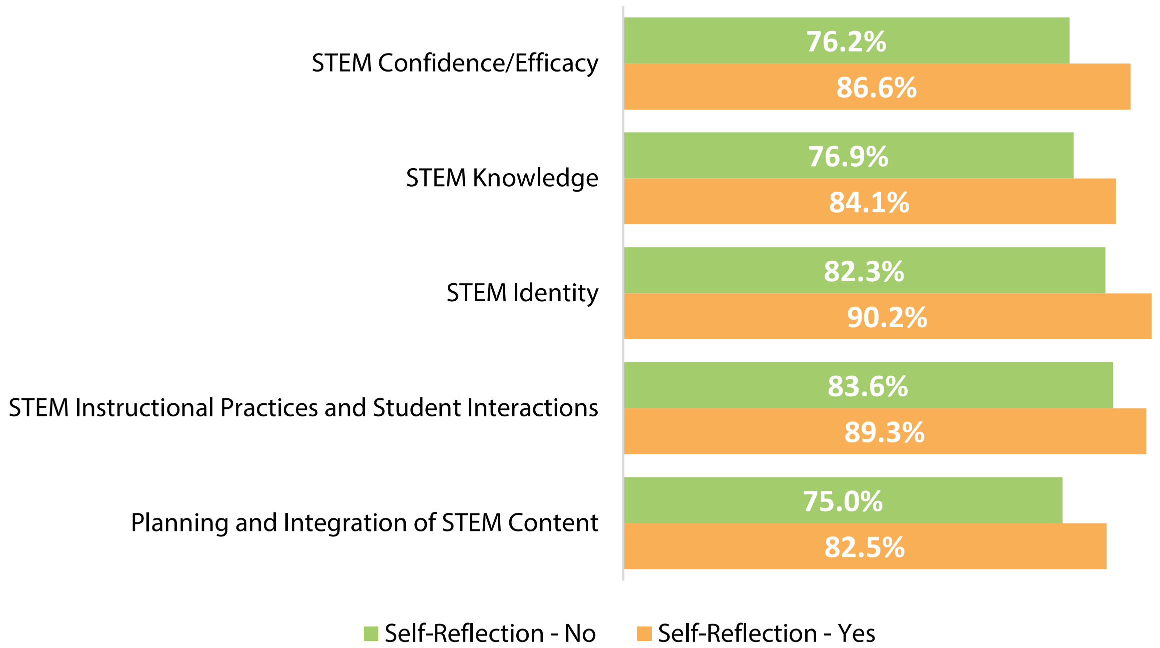
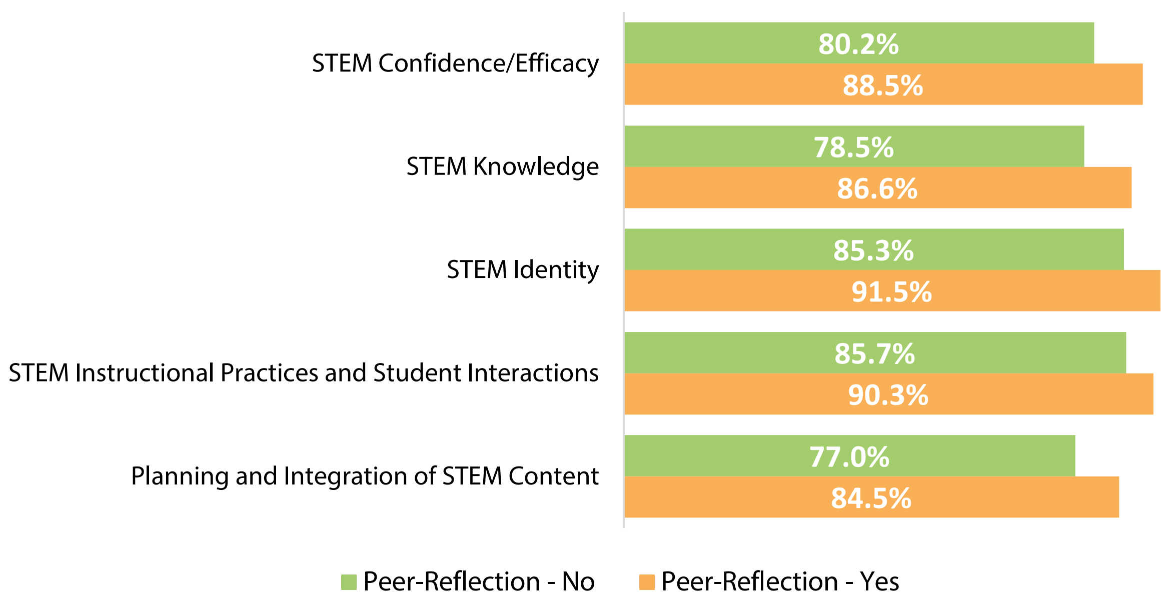


Figure 24. Comparison of Educator Outcomes by Engagement in Video-Based Peer-Reflection



Since participating in the Professional Learning Grant Program, many educators reported spending more time on STEM instruction

Educators reported on the number of minutes they spent engaging in STEM instruction on a daily basis before and after participating in the Professional Learning Grant Program. As shown in Figure 25, educators reported increases in instruction after participating in the program. For example, 38.7% of respondents reported more than 60 minutes of STEM instruction a day versus 31.6% prior to participating. The percentage of individuals engaging in fewer than 20 minutes of STEM instruction each day dropped substantially, from 23.2% to 8.7%.

Figure 25. Daily STEM Instruction Before and After Participating in Professional Learning

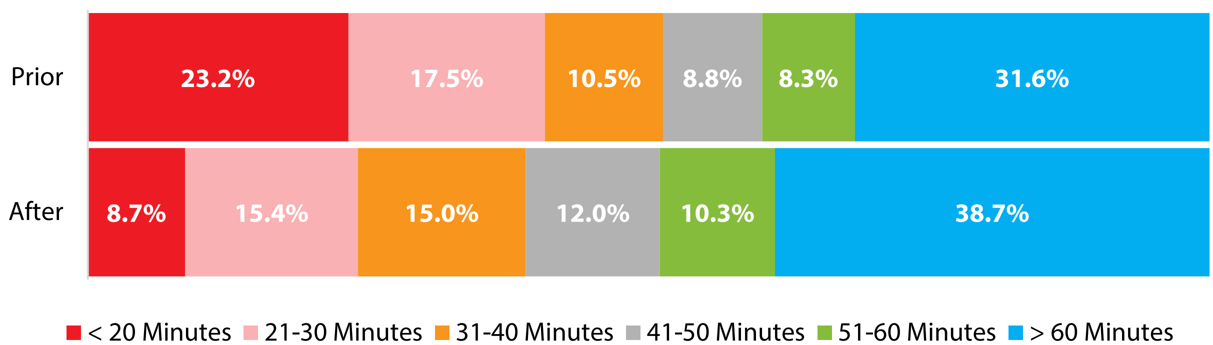
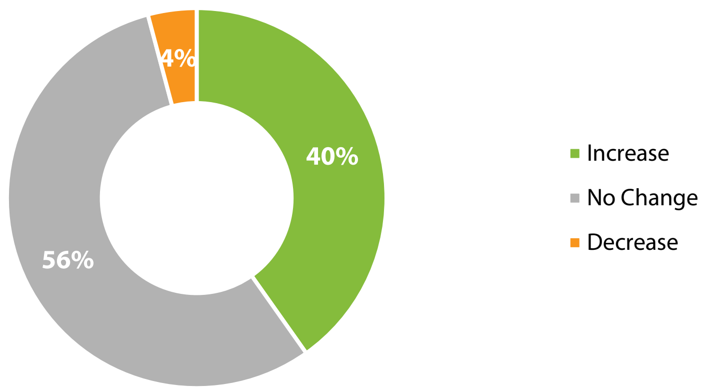


Figure 26 depicts educators' self-reported changes in daily instructional time devoted to STEM instruction since participating in the Professional Learning Grant Program. A large proportion of respondents (40%) indicated that their daily STEM instruction time increased over the course of the 2020-21 school year. Just over half (56%) of respondents indicated no change in their daily STEM instruction time. This includes many individuals who were already teaching at the maximum amount of time on our survey scale (i.e., more than 60 minutes a day). Because they were already at the highest point on the scale, we were unable to observe an increase in their instructional time. Therefore, it is possible that more than 40% of respondents may have experienced an increased in daily STEM instruction time. Only 4% of individuals reported a decrease in their daily STEM instruction time since they began participating in the program.

Figure 26. Change in Daily STEM Instruction Since Participating in Professional Learning



The COVID-19 pandemic presented some challenges for STEM teaching, including shortened instructional time, the virtual environment, and educator fatigue

> "The challenges with COVID have made this year unique and it's been more difficult to integrate STEM activities in my classroom." (Educator survey)

During interviews and open-responses in the UEPC Educator STEM Professional Learning Survey, some educators discussed the ways in which the COVID-19 pandemic impacted their ability to provide STEM-related instruction to students. Within these challenges, three themes arose: 1) decreased instructional time, 2) challenges associated with virtual learning, and 3) teacher fatigue. Some teachers described cuts to instructional time due to shortened school days, which impacted their ability to cover curriculum and engage in certain activities. Virtual school days made engaging in hands-on experiments challenging. For example, in a distance-learning environment, educators would demo the experiment via a Zoom class and then challenge students to do it with their family's support, which some students did, and others did not. Moreover, district and school safety policies around sanitation and staying six feet apart were also challenges for hands-on learning when engaging in STEM learning in the school setting. Lastly, a few teachers described feelings of exhaustion related to pressing pandemic-related needs, which impacted their bandwidth to engage in and implement their professional learning. Here we share illustrative examples about these three challenge areas.

Decreased instructional time

- *Because we received the training during Covid and our school day was a shortened schedule, I didn't apply the learning the way I would have liked to. I'm planning on implementing my learning more thoroughly next year. (Educator survey)*

- *Covid has been influential on the amount of time I take to prepare for STEM and use to teach STEM topics. We have shortened days so often times our team focuses on essentials and push STEM learning to the back. When COVID is not a limiting factor we plan to have a better learning environment and more time for STEM throughout the day and specific STEM lessons. (Educator survey)*

- *The thing that hindered this professional development the most is COVID-19. As a result of COVID 19 our school day has been an hour and 15 minutes shorter each day. All curriculum areas had to be cut in time. This is not helpful for STEM lessons and the science and engineering practices as well as crosscutting concepts are critical thinking skills that develop over time. The shortened time for this school year, I feel has contributed to a deficit in my efficiency as a STEM teacher. (Educator survey)*

Virtual learning

- *I was showing them [an experiment over Zoom], which got [the students] excited to do more science experiments at home. I think a couple of [the students did science experiments at home], but there's not a lot of evidence of them trying it outside of themselves [reporting back to me]. (Educator interview)*

- *With Covid, we didn't get to do as much [hands-on science experiments] because of manipulatives and sanitizing and all of that. We taught science but it definitely wasn't like it has been in the past with experiments. (Educator interview)*

- *I'm tired of Canvas. I'm tired of zoom. I'm tired of technology failing while teaching STEM. Hands-on experiences are so important for STEM. (Educator survey)*

Teacher bandwidth

- *Teaching during COVID has made it really challenging to implement new SEEd STEM standards. I had little science time allotted to science this year, so I feel like PD has been wasted because students and teachers were not in the mindset to be pushed in STEM, as we were being pushed by everything else related to COVID. I hope to increase my STEM teaching abilities in the future, but this year was a rough one for STEM PD. (Educator survey)*

- *Asking us about our attitude about our work after the worst year of education seems a bit ironic. If anyone says they are loving their job right now. I will assume they really were not doing it. This was an overwhelming year for everyone. (Educator survey)*

- *This has been a demoralizing year to be a teacher. I have had no say in my own safety and protection and have been derided and put down by my community when I expressed worry about safety in the school settings. I have been asked to work twice as hard as other years. My fear is that I will be expected to maintain the 'work twice as hard' to have integrated technology with labs and teaching in the classroom without being given adequate time to do it…I am overworked and underappreciated and close to giving up. (Educator survey)*

Educator collaboration was highly appreciated and supported integration of STEM content into lessons

Collaboration and the integration of STEM content into lessons were among the aspects that were most discussed by educators in interviews and commented on in open-ended survey responses. The majority of educators expressed enjoyment related to collaboration and new learning. They also described how much they learned from and with each other, which resulted in higher levels of STEM content delivery in lessons. Educators referenced in-depth summer trainings and curriculum writing that supported their own STEM learning while simultaneously helping them prepare for the coming school year. Once the summer trainings concluded, Professional Learning Communities (PLCs) were one of the main avenues for collaboration during the school year. Educators described integrating the Next Generation Science Standards (NGSS) and Utah's Science with Engineering Education (SEEd) standards into their curriculum during the summer and into their teaching during the school year. Curriculum writing and teaching STEM often occurred in an interdisciplinary manner. Educators described the planning process as "interweaving" standards together. Some educators also expressed that in their context, they did not receive the amount of support they would have liked from either their teaching team and/or school leadership. Nonetheless, overall, educator confidence seemed to increase over the year, as did STEM knowledge and STEM-related skills. The following quotations from educator interviews demonstrate how collaboration expanded educators' STEM understanding:

- *There were two [STEM trainers that] taught us and we took most of [the training] last summer over Zoom, and then a couple of in-person [trainings] throughout the school year. It was nice to have [a STEM trainer] there because I could ask, 'This is what I just did. Is this what you're looking for?' And then she was able guide me through that [curriculum writing]. [The trainers] were supportive. (Educator interview)*

- *[Our school] had 100 percent participation in the PD and in teams... to me, that's an outstanding metric. We now have at least one new Project Based Learning unit in every grade from pre-K through eighth grade, so nine grades worth of [STEM-related] PBL units were newly produced for this year. (Educator interview)*

- *The people who trained us in the SEEd curriculum are excellent. It is my experience, however, that there are problems with two things: 1. district admin and occasionally the leadership at my school don't really care about how things are going for me or my students and are not interested in my opinion or input; and 2. the people I teach with on my grade-level team are not interested in doing any SEEd training or STEM training. I did most of it on my own, and they were not too interested in what I learned… (Educator survey)*

- *I have enjoyed participating in this STEM professional learning. I have improved my teaching. I have enjoyed learning from my peers. (Educator survey)*

Pilot survey results suggest that students of participating educators had high levels of STEM achievement, confidence, identity, interest, and engagement

To what extent do students in classrooms/programs of teachers who have received STEM Professional Learning demonstrate increases in STEM interest, engagement, confidence, STEM identity, and achievement as a result of teachers' participation in STEM Professional Learning?

To evaluate the extent to which the Professional Learning Grant Program was associated with positive outcomes for the students of educators who participated in the program, we piloted the UEPC Student STEM Survey in a single district during the 2021-21 school year, as described in the methods section. Because this was a pilot in a single district, results from this pilot survey cannot be generalized to all students whose educators participated in the program. A subsequent addendum report will present and analyze educator survey responses to items measuring student outcomes to provide further context and nuance. Figure 27 summarizes the results of the pilot survey. Noted with bolded text on the left-hand side of the figure, students responded to survey items about five different STEM constructs – achievement, confidence, identity, interest, and engagement. Below each bolded topic are the individual survey items included in the construct. To the right of each construct or individual survey item is a percentage. This value represents the percentage of responses that were either "agree" or "strongly agree" on a five-point Likert scale ranging from "strongly disagree" to "strongly agree."

Beginning with the first value in Figure 27, 95% of responses provided to survey items asking students about their STEM achievement were either "agree" or "strongly agree." Following this are the levels of agreement for each individual survey item within the achievement construct. This figure demonstrates that 95% of respondents agreed that they do well in STEM class activities, complete STEM homework, help classmates with STEM classwork, and believe they can do well on future STEM assignments. Slightly fewer (93%) of students agreed that they earn good grades in STEM courses. Collectively, these responses suggest that students who participated in the pilot administration of the survey believe that their STEM achievement was high.

Within the STEM confidence construct, 89% of survey responses were either "agree" or "strongly agree." Responses to individual survey items ranged from 87% to 93%. Similar to perceptions of achievement, we found that STEM confidence was high among pilot survey participants.

As with confidence, 89% of responses to items measuring STEM identity were either "agree" or "strongly agree." We found more variation in responses to individual survey items within this construct. At the lowest level of agreement, only 83% of students agreed that others asked for help with STEM. At the highest level of agreement, 94% of respondents agreed that they were good at STEM and that they understand STEM.

Agreement with items measuring STEM interest was 90% for both the overall construct and the individual survey items. For the most part, pilot survey respondents agreed that they feel excited about STEM instruction, that STEM instruction is enjoyable, that STEM materials are fascinating, and that they feel positive about attending STEM courses.

Within the STEM engagement construction, 82% of responses were either “agree” or “strongly agree,” but agreement with individual survey items ranged from 79% to 89%. Students were less likely to report at they raise their hand in STEM courses or talk about STEM outside of class (79%) and more likely to report that they listen attentively in STEM courses (89%).

Collectively, these results suggest that students of educators participating in the Professional Learning Grant Program had high levels of STEM achievement, confidence, identity, interest, and engagement. We remind the reader that these results come from a single district and are not necessarily representative of all students who educators participated in the program. Our 2021-22 evaluation will invite all participating LEAs and schools to allow their students to take this survey.

Figure 27. Students' Self-Reported Perceptions of STEM Achievement, Confidence, Identity, Interest, and Engagement (Pilot Survey Results)

STEM Action Center as an Intermediary

What is the role of the STEM Action Center as an intermediary in facilitating and/or supporting STEM Professional Learning?

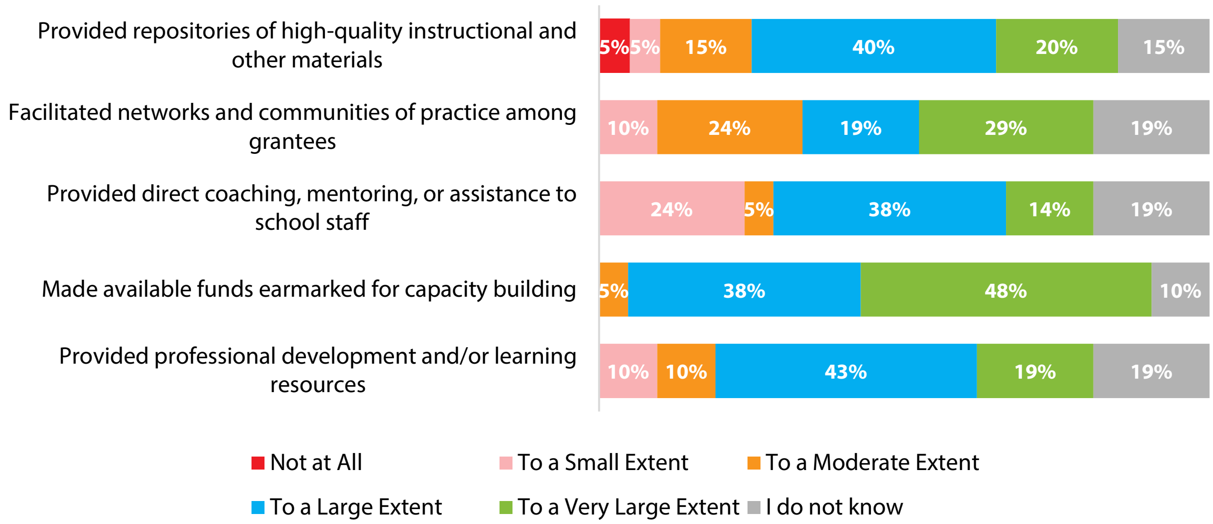
To evaluate the role of the STEM Action Center as an intermediary in facilitating and supporting the Professional Learning Grant Program and educators, we examined UEPC Educator STEM Professional Learning Survey data and interview data. In particular, we considered survey responses provided by administrators who were asked to provide feedback about the STEM Action Center. Overall, we found that the STEM Action Center provided meaningful support to schools and districts in the form of resources, and to a lesser extent, direct services. Administrators viewed STEM AC's efforts to support the scaling up of professional learning favorably.

Administrators and educators positively perceived STEM AC's efforts to support STEM professional learning, provide resources, and to a lesser extent, direct services

Administrators who participated in the UEPC Educator STEM Professional Learning Survey were asked a series of questions about their perceptions of the STEM AC. As noted earlier in the methods section, 25 administrators from 12 unique districts participated in the survey.

When asked about STEM AC's efforts to build capacity and practice of educators, administrators generally reported positive perceptions. As illustrated below in Figure 28, in nearly all cases, the majority of respondents selected either "to a large extent" or "to a very large extent" in response to the items about STEM AC's role in supporting professional learning. These responses represent the two highest values on a five-point scale ranging from "not at all" to "to a very large extent." For example, 60% of respondents reported that the STEM Action Center provided repositories of high-quality instructional and other materials to a large or very large extent. We also observed that perceptions of the STEM Action Center were relatively high in regard to their ability to make available funds earmarked for capacity building and provide professional learning resources, with 86% and 62% of respondents, respectively, selecting either "to a large extent" or "to a very large extent."

Figure 28. Administrators' Perceptions of STEM AC's Efforts to Build Capacity and Practice of Educators



In contrast, fewer educator survey respondents felt that the STEM Action Center facilitated networks and communities of practice among grantees or provided direct coaching, mentoring, or assistance to school staff (48% and 52%, respectively, selected "to a large extent" or "to a very large extent"). This finding was corroborated by educator interviews. Educators expressed appreciation for grant monies that allowed them to engage in new ways of STEM teaching and learning; at the same time, educators reported they did not have direct contact with the STEM Action Center team members. An interview with a STEM Action Center staff member provides context for this: "As far as professional learning, [STEM AC] provides very limited actual personal learning. We support the districts and schools plans for professional learning." Importantly, interviewees who did interact with directly with the STEM Action Center team reported having positive and supportive interactions, including resources and support for grant fidelity, with the STEM Action Center:

- *[STEM AC support] was usually through the district and so our district person, she has worked with [STEM AC] a lot. So as far as learning from her what the priorities are from the STEM Action Center, we were able to build that in there. But, as far as a direct connection, I did not get to have that with them this year. (Educator interview)*

- *I've had great support, particularly from [STEM AC personnel], on grant fidelity. That's really important, because if you're not doing your grant right, you're not going to not only get the money. (Educator interview)*

- *I think that the support that we've received from the STEM Action Center is really the push behind what we've done. I honestly don't think we would have done what we've done [without the grant]. That's just the bottom line. (Educator interview)*

Overall, these results indicate that during the 2020-21 school year, the STEM Action Center tended to serve more often as a provider of resources (e.g., materials, funds) rather than direct services (e.g., networking, direct support).

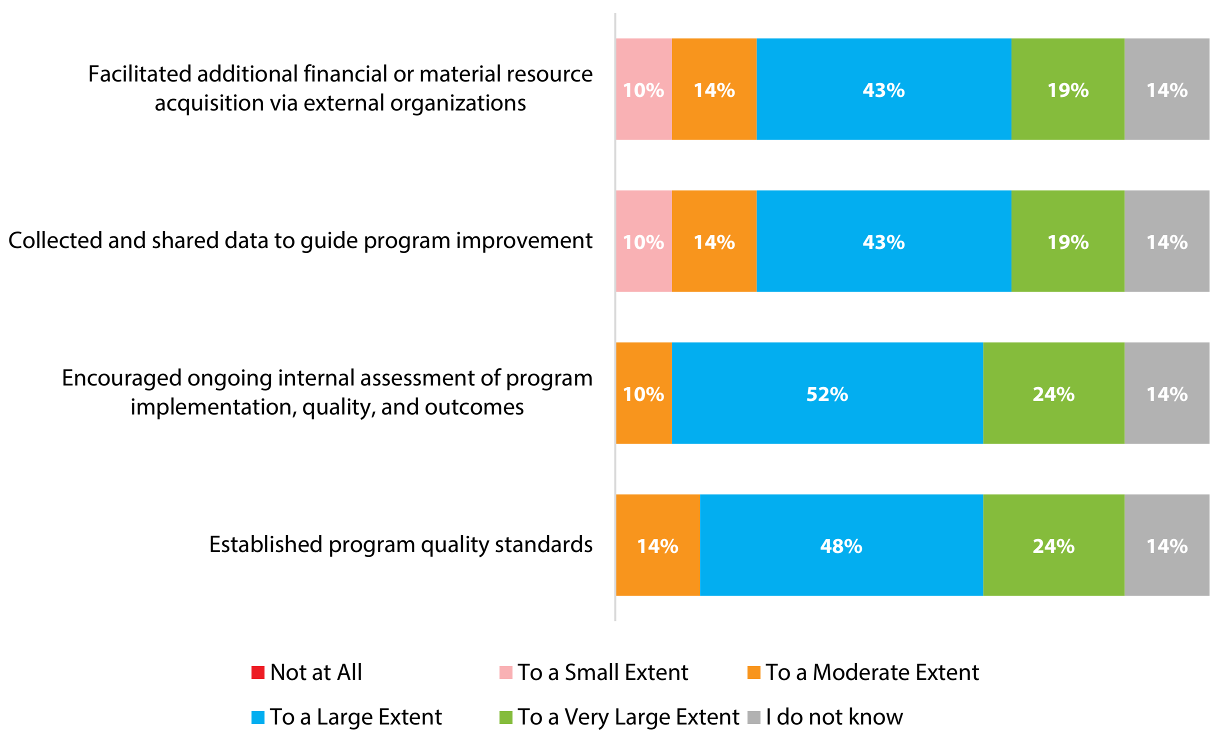
Administrators viewed STEM AC's efforts to support the scaling up of professional learning favorably

> "I appreciate the support STEM AC gives to school districts in funding these programs." (Educator survey)

As part of the UEPC Educator STEM Professional Learning Survey, administrators were also asked to rate the extent to which the STEM Action Center supported the scaling up of professional learning. As with the previous results section, we remind the reader than only 25 administrators from 12 districts participated in the survey. As such, these findings may not necessarily represent the perceptions of all administrators involved in the Professional Learning Grant Program.

Summarized in Figure 29, we found that the majority of administrators held positive perceptions of the STEM Action Center's efforts to support the scaling up of professional learning. In all cases, at least 62% of respondents reported that the STEM Action Center facilitated resource acquisition via external organizations, collected and shared data to guide program improvement, encouraged ongoing internal assessment, and established program quality standards "to a large extent" or "to a very large extent."

Figure 29. Administrators' Perceptions of STEM AC's Efforts to Support the Scaling up of Professional Learning



Discussion

Summary of Findings

This evaluation of the STEM Action Center's Professional Learning Grant Program considered interview data, survey data, and secondary data sources to understand the extent to which educator and student outcomes were achieved, how program implementation varied by district/school, and what role the STEM Action Center played as an intermediary. Key findings are summarized below in alignment with the three major sections of findings presented in this report.

Key Finding #1: Educators had positive perceptions of program implementation, but there was variation across programs

Professional learning was implemented differently based on the unique project and context. Only about half of educators reported engaging in activities such as peer observation and co-teaching. Use of data also varied; approximately four in five educators reported that they used student work or other data sources in their professional learning communities, while the remaining 20% reported that they did not. Despite this variation, a majority of educators had positive perceptions of program implementation.

Key Finding #2: The STEM AC's Professional Learning Grant Program generally resulted in positive educator outcomes and increased STEM instructional time

Through interviews and surveys, educators reported positive outcomes as a result of participating in the Professional Learning Grant Program. A majority of participants agreed that their participation in professional learning resulted in positive STEM outcomes in six domains—efficacy/confidence, knowledge, identity, skills and application of skills, and their ability to plan and integrate content. Moreover, among educators who participated in video-based self- and peer-reflection, these outcomes were particularly strong. Most notably, at least 40% of participants reported spending more time on STEM instruction as a result of their participation in the program.

Key Finding #3: Student outcomes as a result of educators' participation in professional learning were strong, despite the challenges of the COVID-19 pandemic

Educators reported that their students had high levels of interest and engagement in STEM as a result of their participation in the Professional Learning Grant Program. This finding is further substantiated by pilot student survey results. Students in one participating district reported high levels of STEM achievement, confidence, identity, interest, and engagement. Educators, however, did identify a number of challenges in their efforts to provide STEM instruction this past year. Because of the COVID-19 pandemic, learning activities did not always go as planned.

Key Finding #4: The STEM Action Center provided support to districts and schools, supporting efforts to scale up professional learning

The STEM Action Center provided extensive support to district and schools. As noted by educators and administrators, the STEM Action Center commonly provided resources to programs and in some cases, direct services. Nearly all administrators agreed that the STEM Action Center provided funds and other resources, while fewer participants reported received direct services such as coaching, mentoring, or assistance. Most administrators agreed that the STEM Action Center supported their efforts to scale up professional learning.

Program Considerations

We conclude our evaluation of the STEM Action Center's Professional Learning Grant Program with several program considerations. Intended to support continuous improvement efforts, these program considerations were identified in light of our analysis of interview and survey data. These considerations might guide the STEM Action Center's future program planning in the 2021-22 school year as they strive to strengthen STEM education in Utah.

Consideration #1: Place additional emphasis on the importance of differentiating STEM content to meet all students' learning needs

Nearly one in five participants did not feel they were able to differentiate STEM instruction and adjust STEM content to meet the needs of all students. As professional learning resumes for the 2021-22 school year, programs might benefit from placing additional emphasis on differentiation to ensure that all students' needs are met. A synthesis of research on best practices for STEM professional learning found that programs are most effective when they help educators understand how content can be understood by all students and how students learn (Hill et al., 2020). One strategy that may support educators' efforts to differentiate instruction is video-based reflection. We found that educators who engaged in video-based peer- and self-reflection had stronger outcomes than those who did not. By received formative feedback from colleagues and reflecting on their own practices, educators may be better equipped to tailor instruction to students at varying levels (Radloff & Guzey, 2017). In the coming year, professional learning communities might consider engaging in video-based reflection with an emphasis on differentiation.

Consideration #2: Encourage educators to use a variety of data sources, including student work, as a part of their professional learning

There is room for improvement in the use of data as a part of educators' STEM professional learning communities. Approximately one in five educators did not agree that multiple data sources, including student work, were regularly used to assess the effectiveness of instructional practices. Research continues to support the importance of analyzing multiple data sources within professional learning communities, such as student work, to improve student outcomes (Vescio, Ross, & Adams, 2008). However, educators may not have the requisite skills to use these data sources to effectively support teaching and learning. To ensure that educators have the ability to utilize data, the STEM Action Center might encourage programs to place additional emphasis on the importance of understanding and using multiple data sources. STEM professional learning communities might consider identifying team members with an expertise in data who could serve as coaches or leaders within their teams (Marsh et al., 2015).

Consideration #3: As educators continue to navigate professional learning and teaching during the COVID-19 pandemic, resume in-person support to the extent possible

During the 2020-21 school year, many educators struggled to participate in coaching activities such as peer observation and co-teaching. In part, this may have been due to the COVID-19 pandemic. With

COVID-19 safety precautions and limited in-person instruction in some school settings, many educators experienced additional difficulties in navigating the logistics of observation, co-teaching, and meeting in professional learning communities. As noted by educators, hands-on STEM learning activities were also hampered this past school year for similar reasons. Looking ahead to the 2021-22 school year, educators and students will likely benefit from increased in-person teaching and engagement. However, intentional planning and engagement in activities such as peer observation and hands-on learning will be beneficial (Cambridge Assessment International Education Teaching and Learning Team, 2019; Christensen et al., 2015)

Consideration #4: Strengthen collaboration, particularly empowerment, among educators by acknowledging achievements, encouraging participation in the creation of content, and pacing professional learning appropriately

Professional learning communities involved in the Professional Learning Grant Program might benefit from taking steps to strengthen collaboration, particularly empowerment. Approximately one third of educators reported that achievements were not recognized, their participation in the creation of content was not encouraged, and professional learning was not paced appropriately. Collectively, these findings suggest that some programs might benefits from taking additional steps to empower all participating educators (Garmston & Wellman, 2016; Kohm & Nance, 2009).

Consideration #5: Continue to strengthen the STEM Action Center's capacity to serve as an intermediary organization

In the spirit of continuous improvement, we conclude with a brief overview of best practices for intermediary organizations engaged in work similar to that of the STEM Action Center. Intermediary organizations play a key role in the implementation of education policy and programming through six key roles (Turner et al, 2012):

- Guide vision and strategy
- Support aligned activities
- Establish shared measurement practices
- Build public will
- Advance policy
- Mobilize funding

We encourage the STEM Action Center to reflect on the extent to which the Professional Learning Grant Program fulfills each of these roles. To ensure that the Professional Learning Grant Program has a lasting impact on STEM education in Utah, the STEM Action Center might also consider program sustainability and the extent to which districts and schools are equipped to continue professional learning efforts beyond the duration of the program (Honig, 2004). By approaching the STEM Action Center's role as one of program leadership more so than program management, the organization can ensure that this work has a lasting impact on educators and students in Utah.

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