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

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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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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

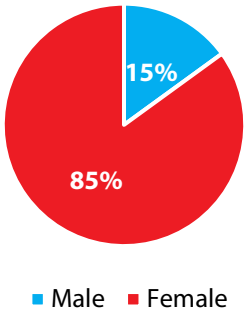


Figure 2. Educator Survey Participant Position Type by Gender

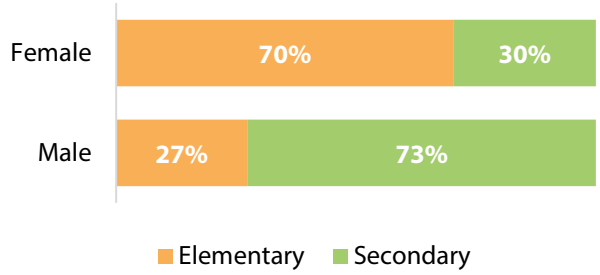


Figure 3. Educator Survey Participant Experience

[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

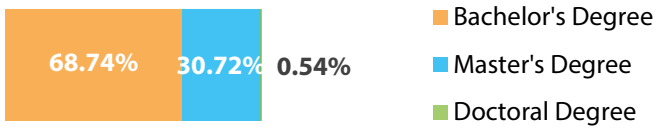


Figure 5. STEM Subjects Taught by Educator Survey Participants

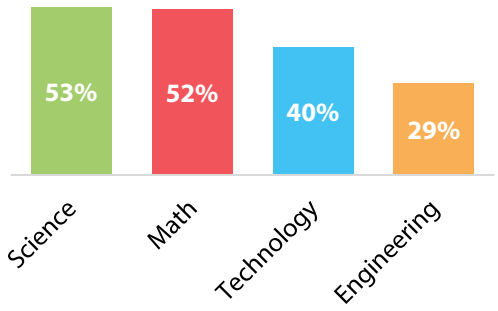
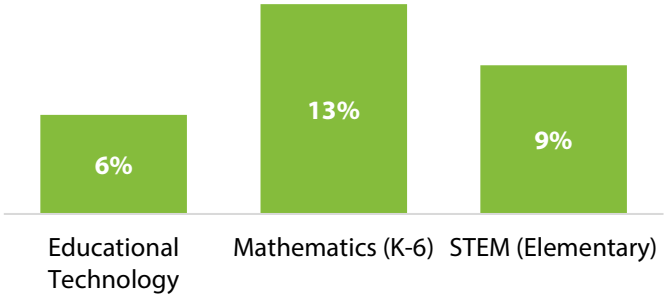


Figure 6. STEM Endorsements among Elementary Educator Survey Participants



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

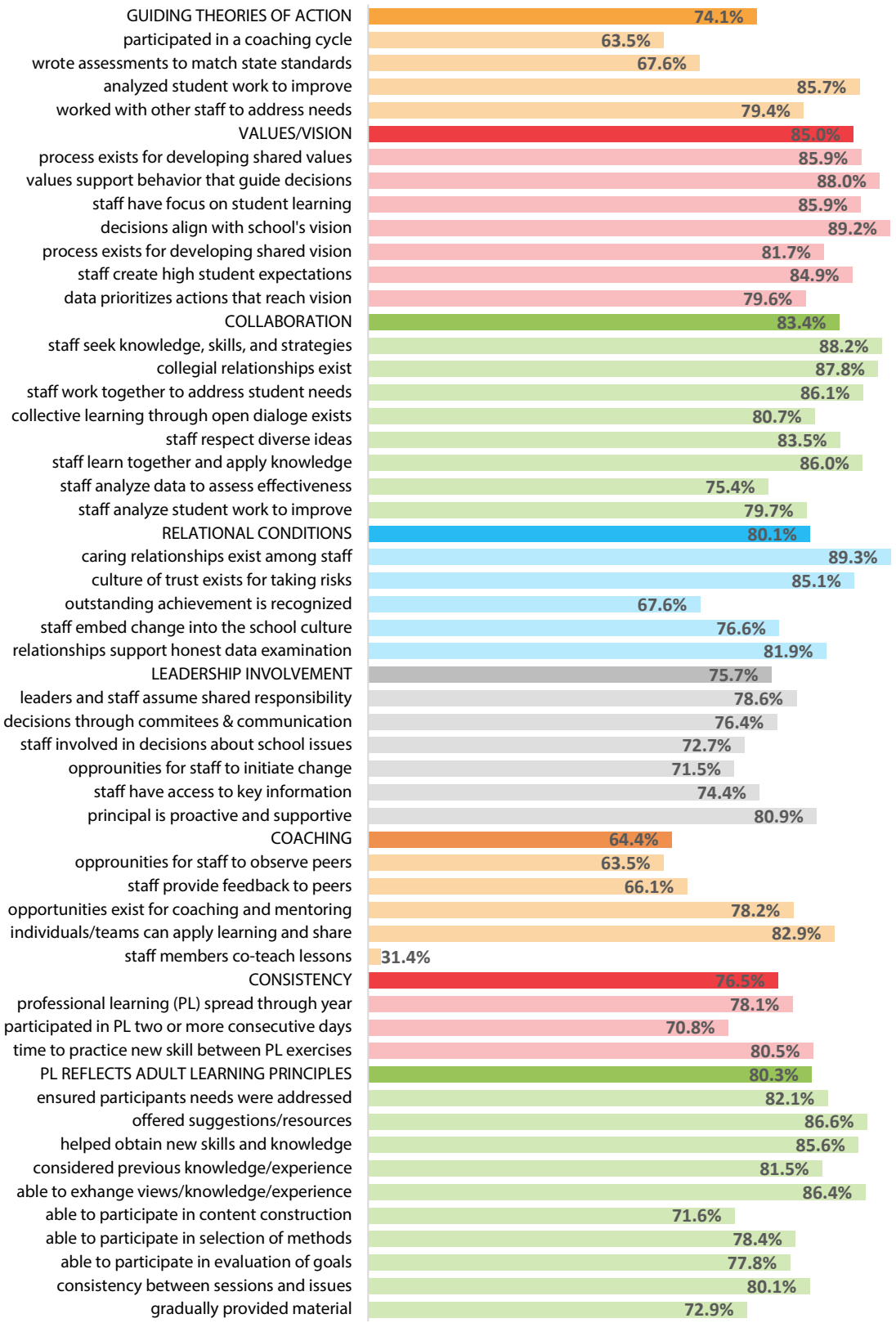
"STEM professional learning has guided me to provide a learning environment that will help students succeed in the future." (Educator survey)

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.

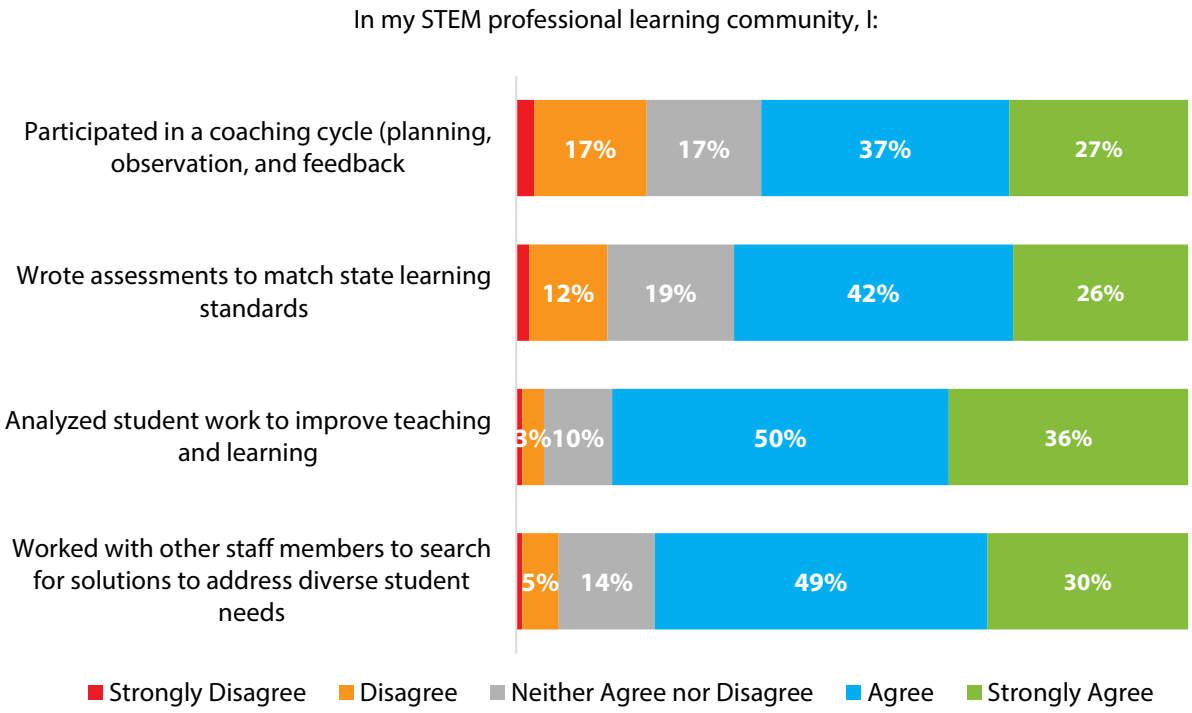
Figure 7. Rates of Agreement with Measures of Professional Learning Program Implementation



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.'

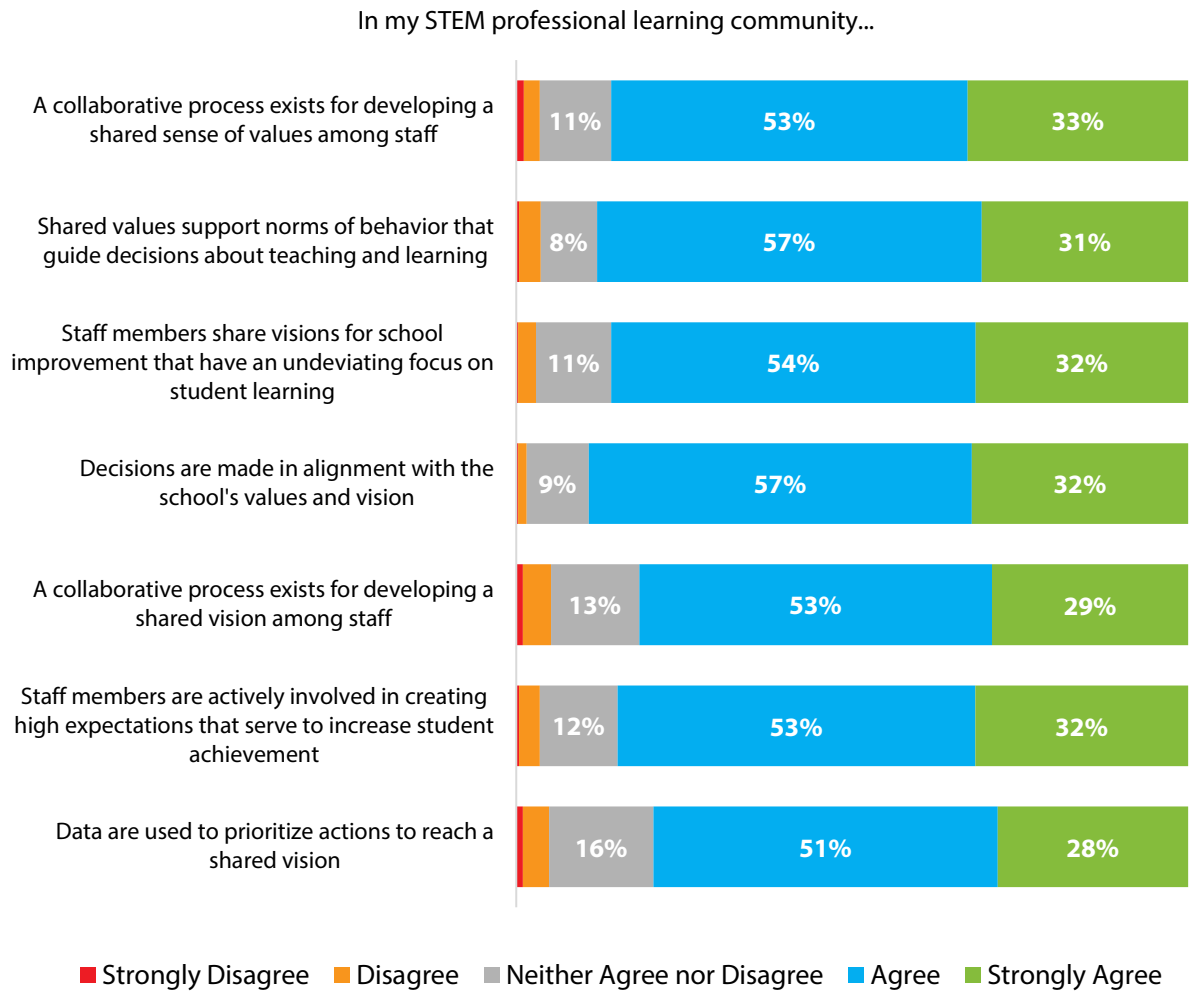
So we were able to increase their interest in what they were learning about when they could see a real-life application. And with that interest, comes the engagement. They were really into it. 'Oh, yeah. What would I say to grandma? How would I convince her?' … They were able to tie in what we were doing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

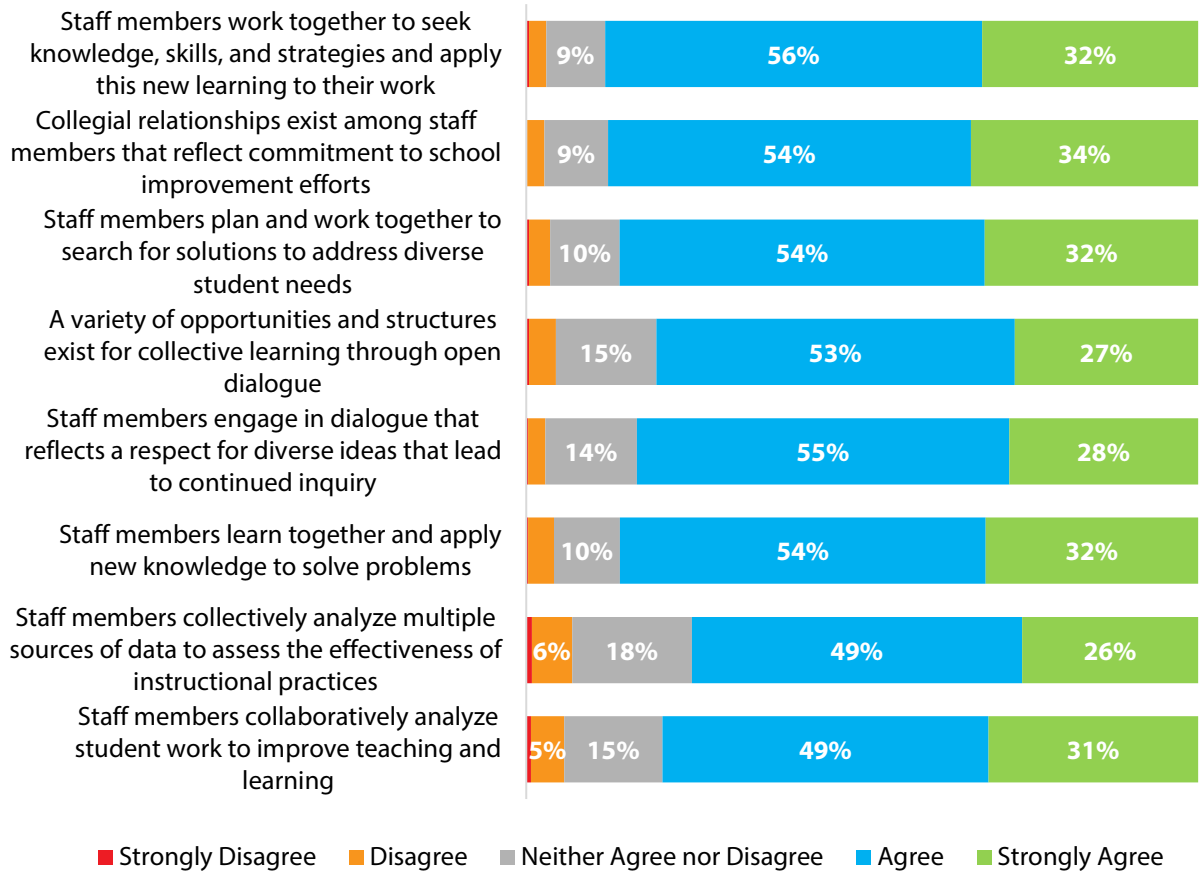
Figure 9. Educator Reports of the Alignment of Practices to Values and Vision



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:

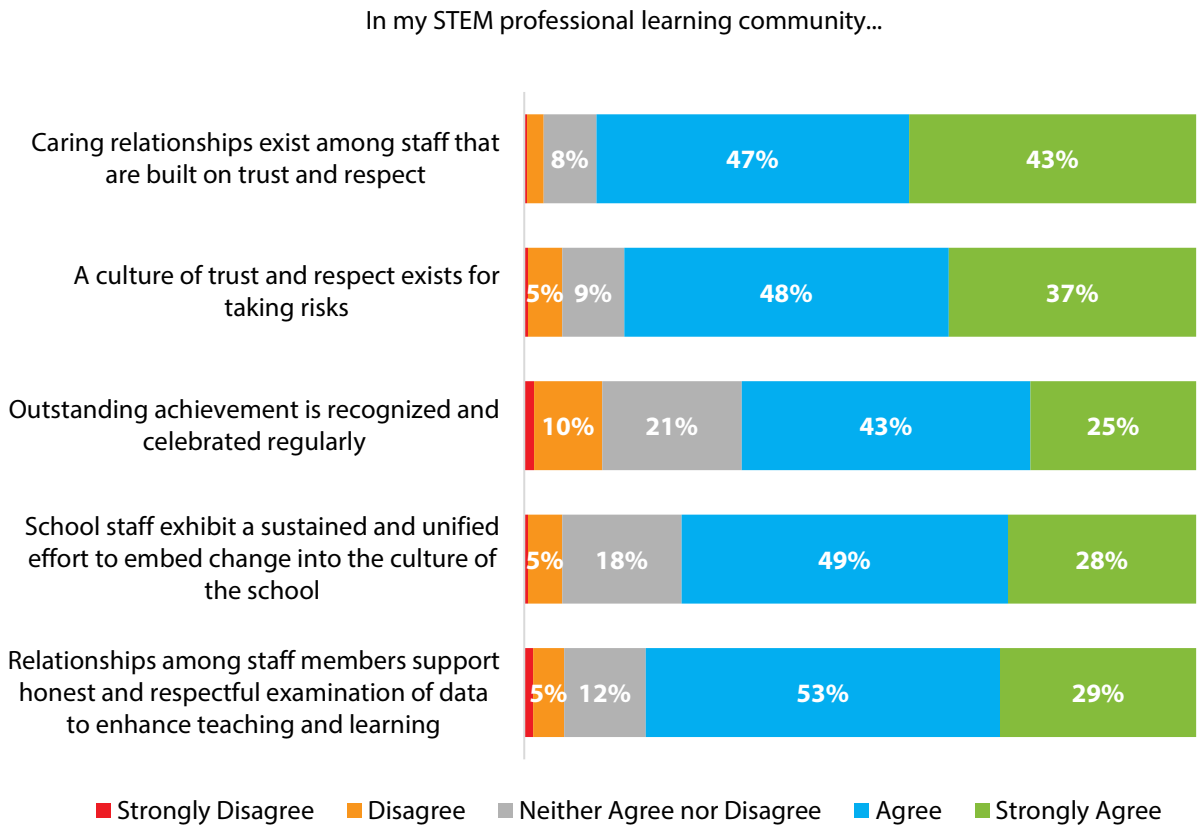
- *I love my job, but I struggle with collaboration. To me, there is a very large focus on collecting data, but very little training on how to turn the data into meaningful change or improvement. We have had some collaborative experiences in which we spend more than an hour looking at data, only to then 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

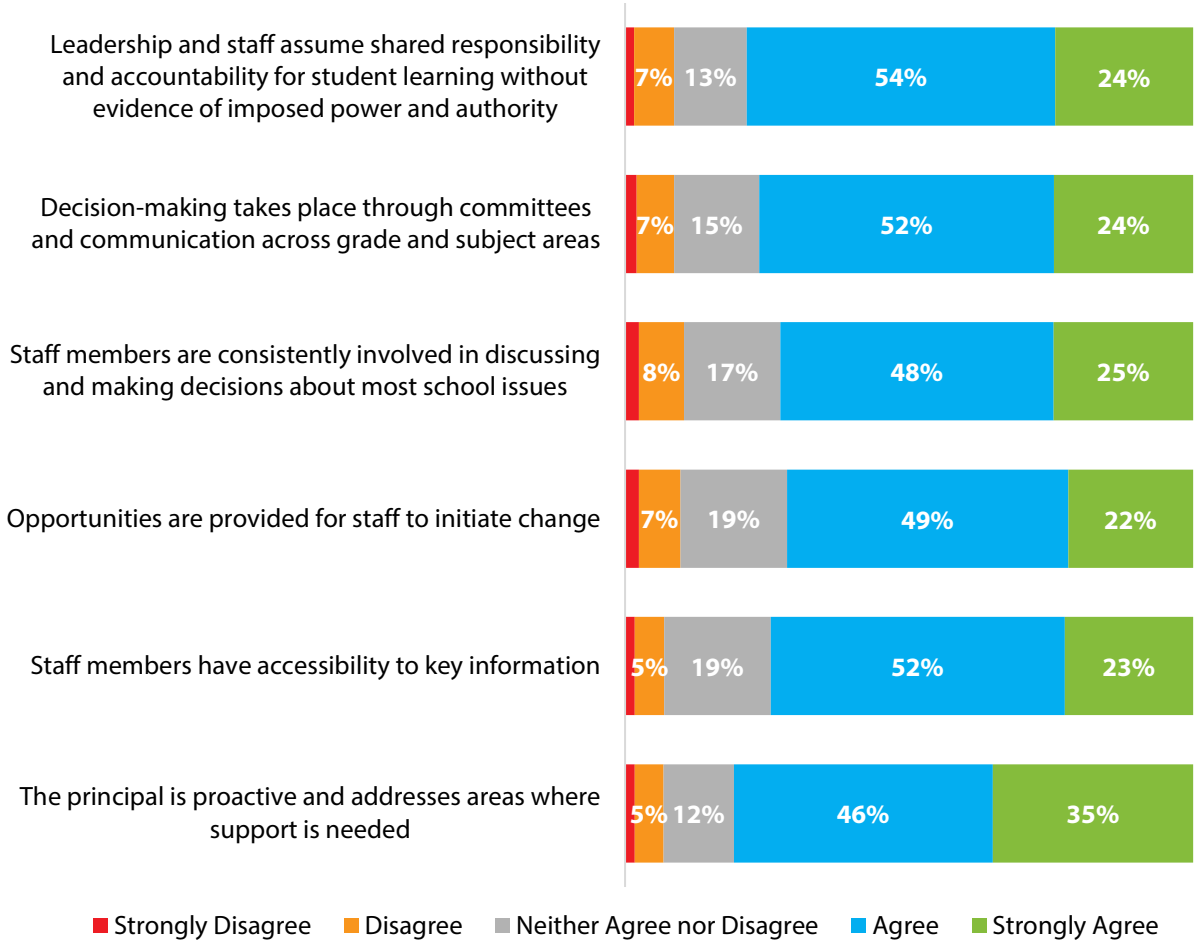


Educators commonly reported proactive administrators and shared responsibility, but did not always feel they had the ability to initiate change

"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)*

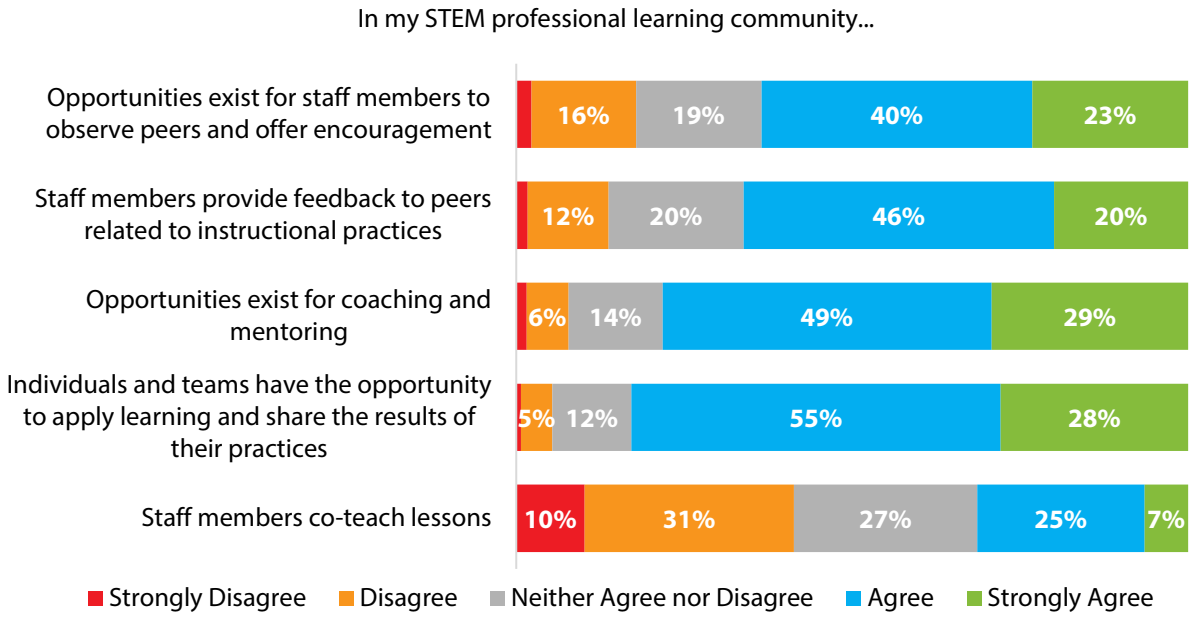
However, fewer respondents agreed that there were opportunities for staff members to initiate change (71%) and participate in decision-making about school issues (73%). One educator commented: "District admin and occasionally the leadership at my school…are not interested in my opinion or input." While 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

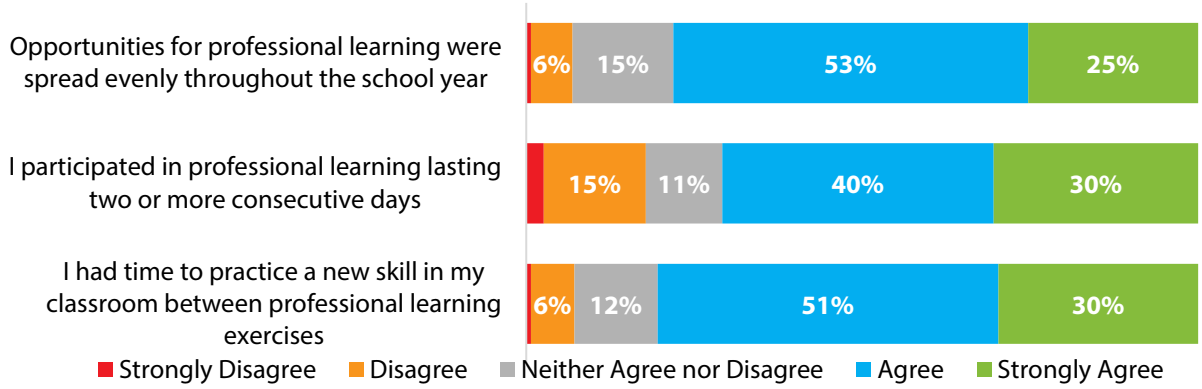


Professional learning varied in consistency, duration, and design across contexts

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)*

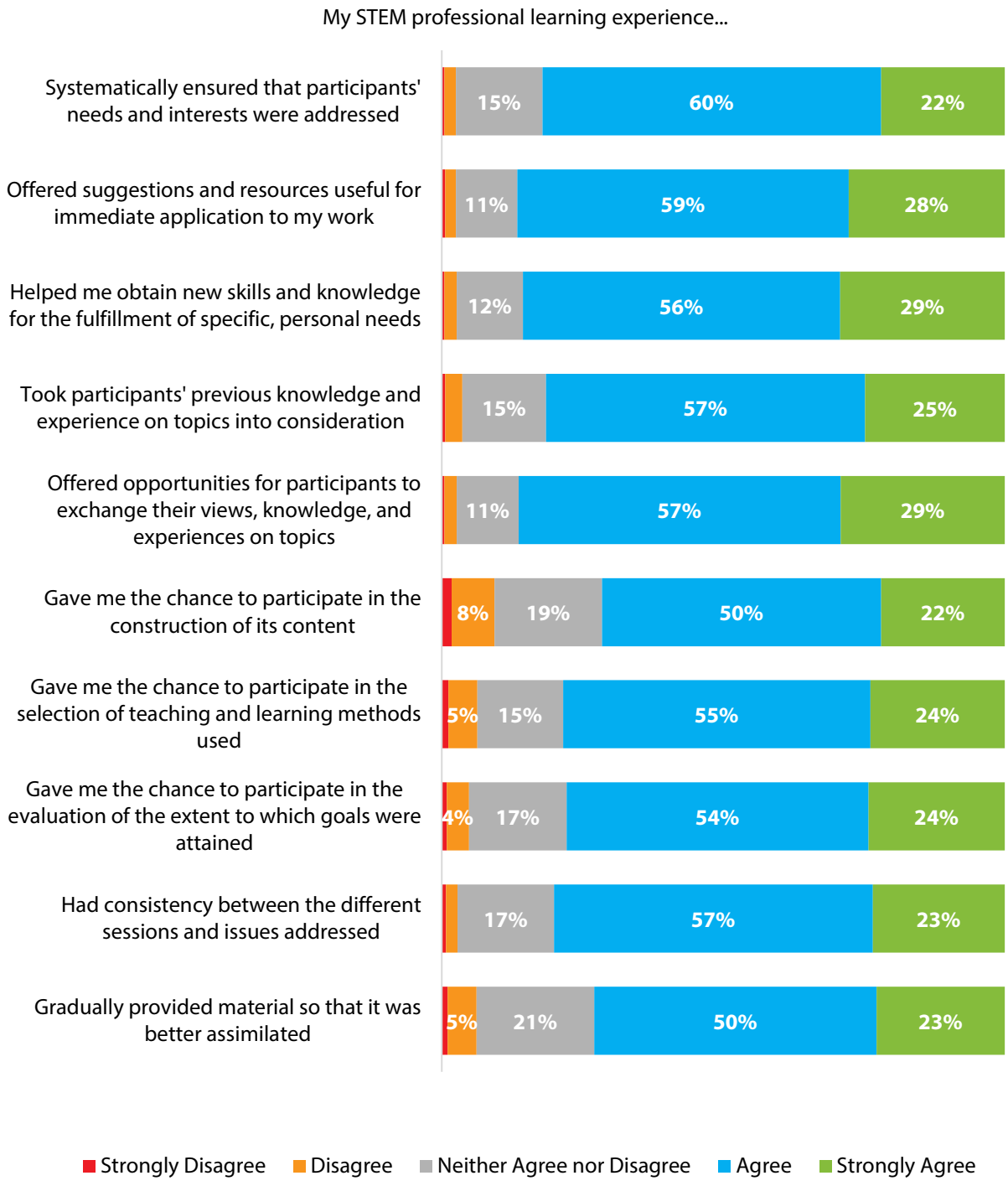
Most educators received suggestions and resources they could immediately apply to their work

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



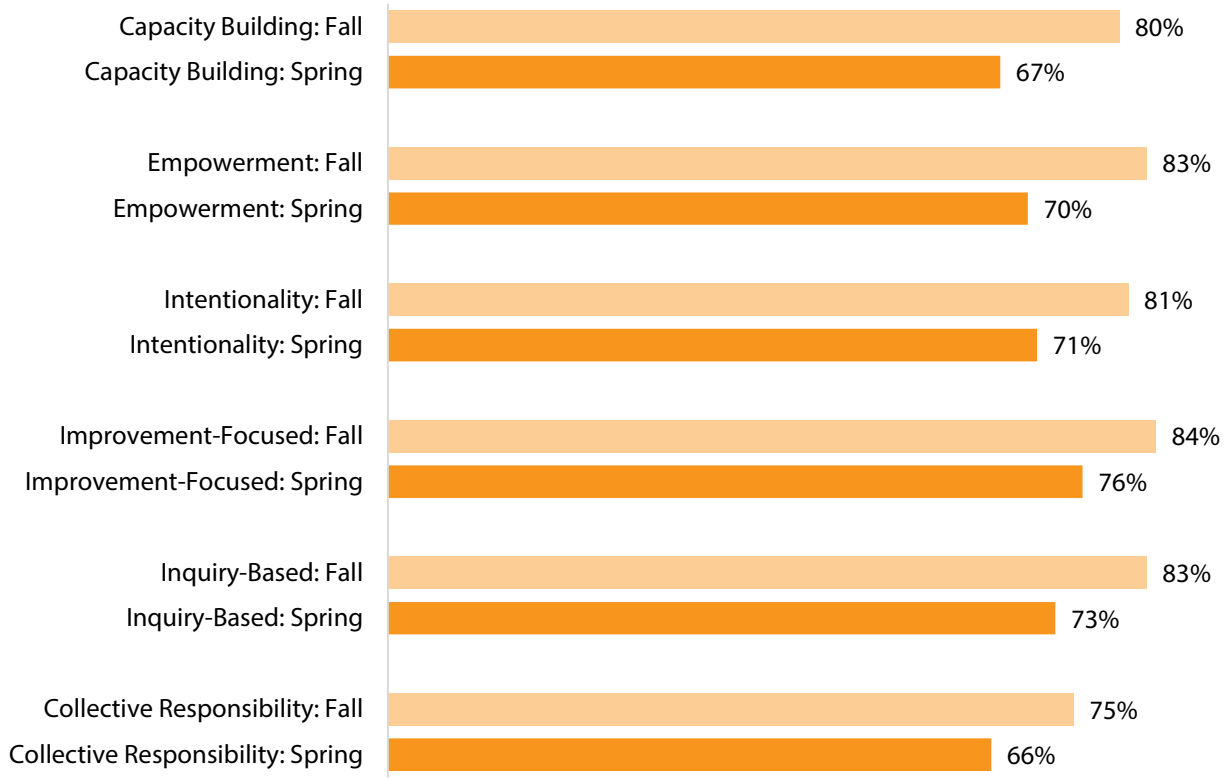
As the COVID-19 pandemic impacted schools, self-reported levels of educator collaboration declined substantially during the 2020-21 school year and varied by district/school

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.

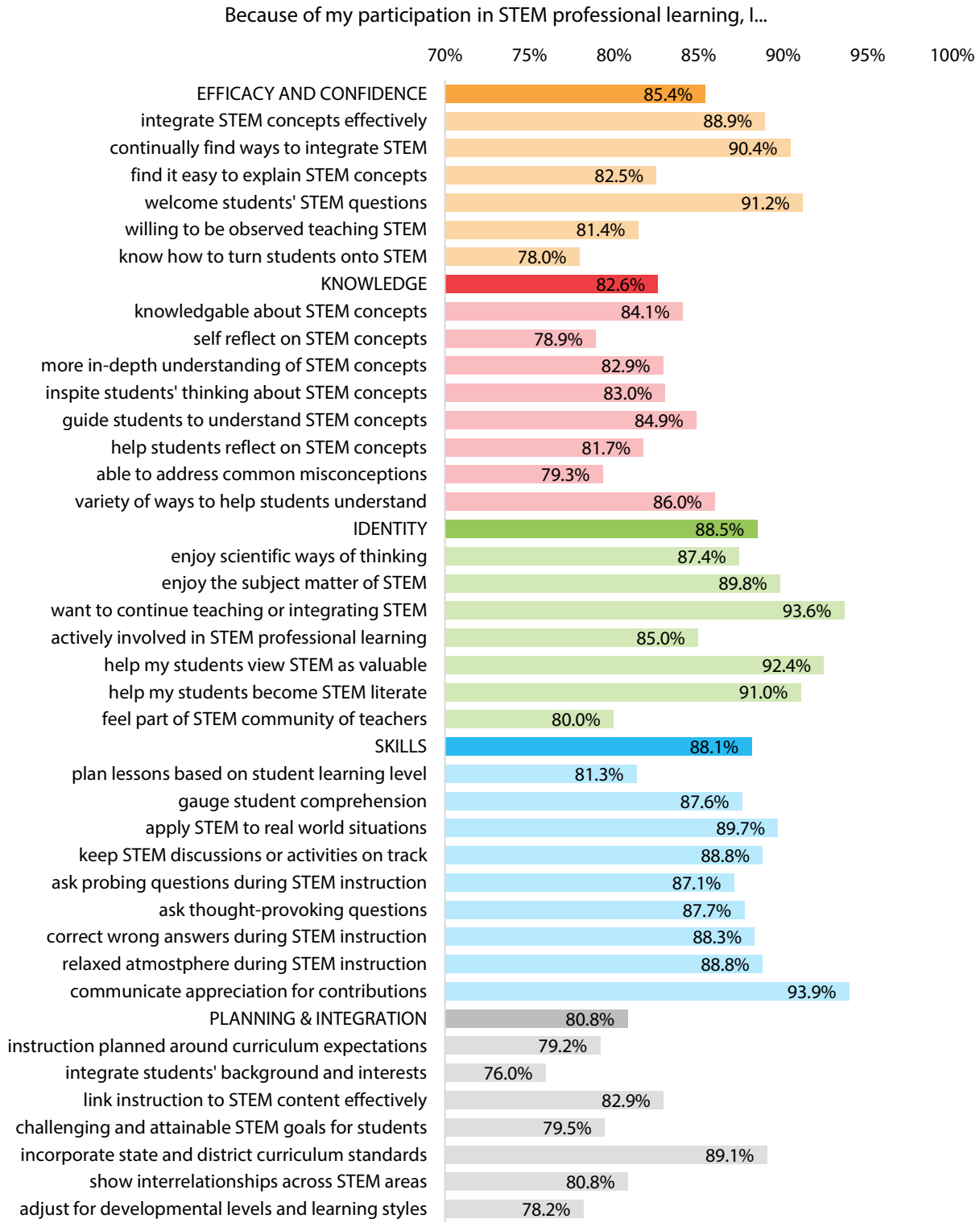
How effective is STEM Professional Learning in increasing teacher outcomes in efficacy, confidence, STEM knowledge, STEM identity, skills and application of skills, collaboration, and planning and integration of STEM content?

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

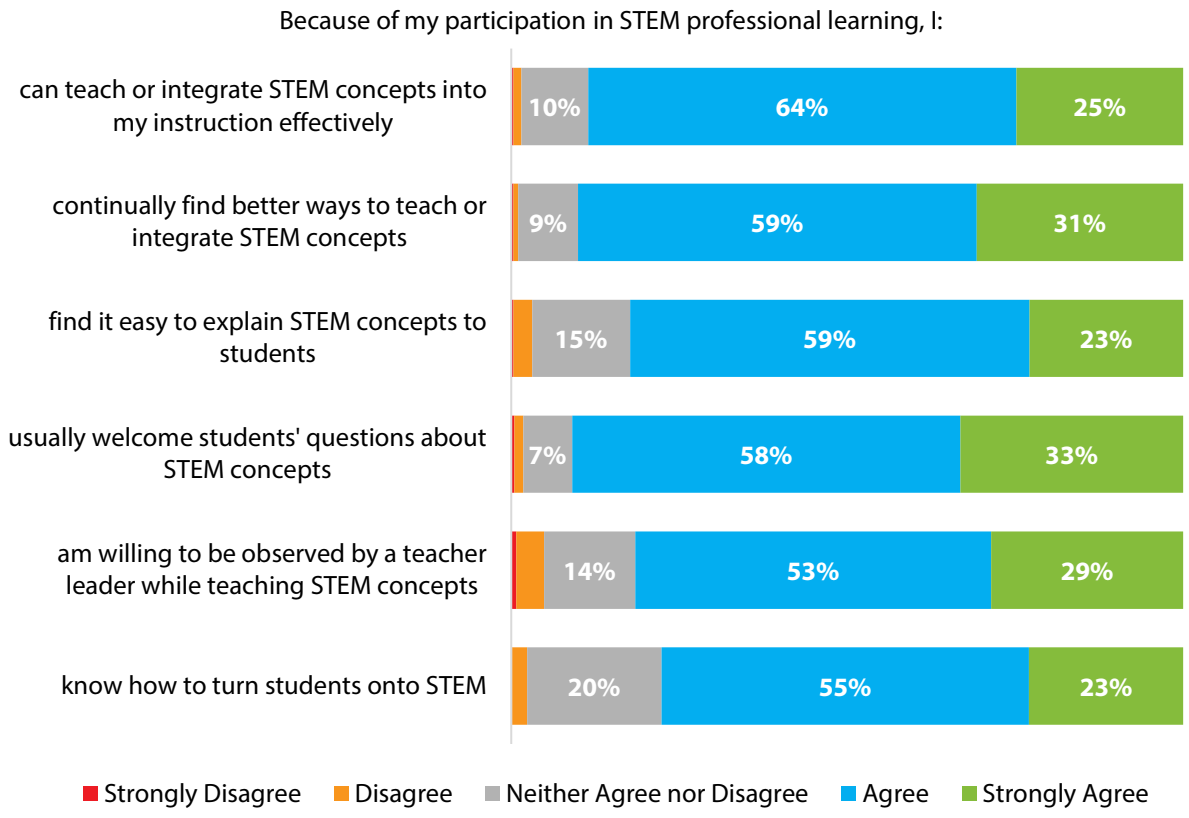


Educators reported high levels of STEM efficacy and confidence, particularly with answering students' questions about STEM concepts

> "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

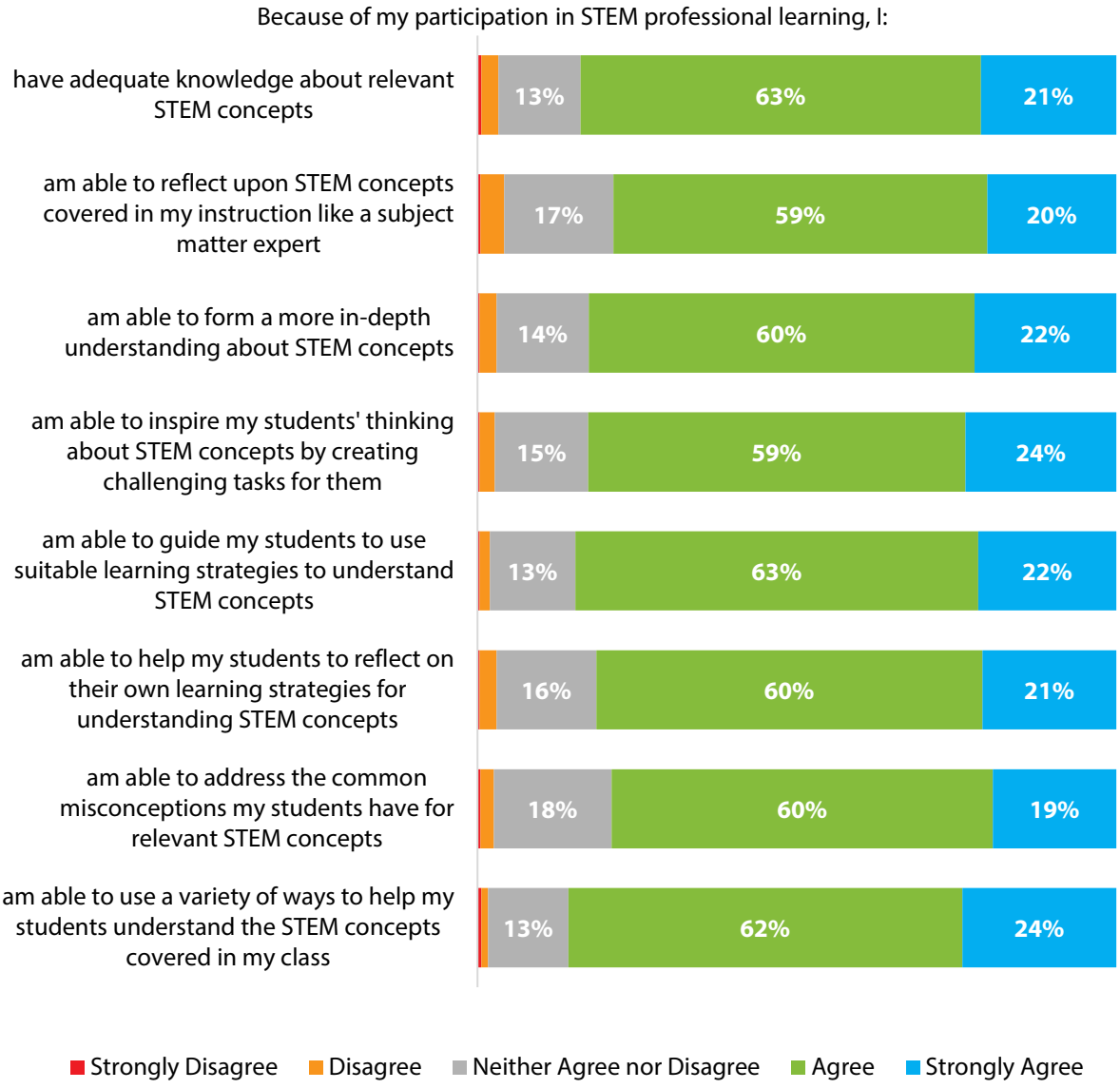


Educators reported high levels of STEM knowledge, noting that they could use a variety of approaches to help students understand STEM

> "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

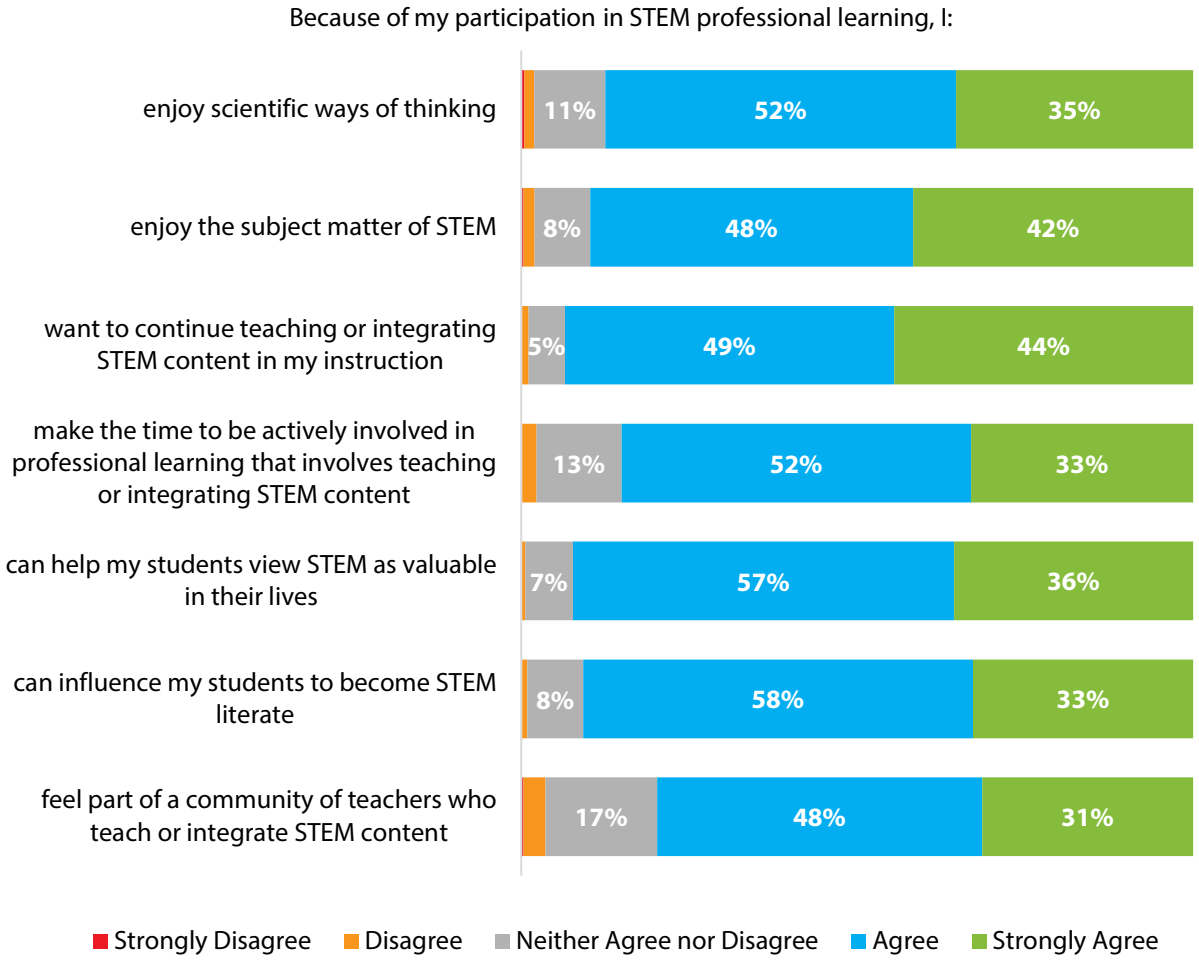


Educators generally reported strong STEM identities and influence on students, though one in five respondents did not feel they belonged to a community of teachers who teach or integrate STEM content

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

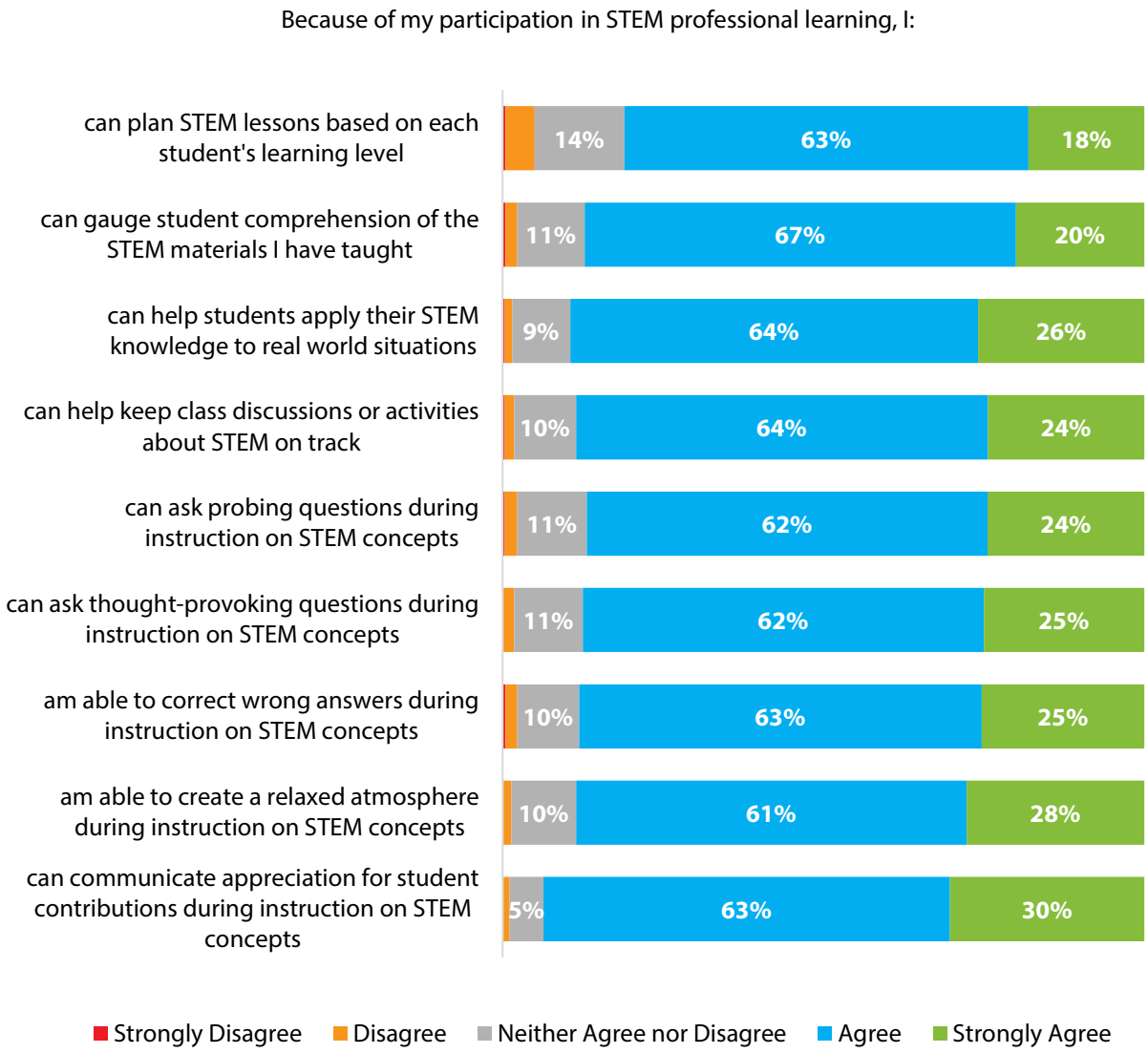


Self-reported STEM instructional practices were generally high among educators, while opportunities exist to better differentiate instruction based on student learning levels

> "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



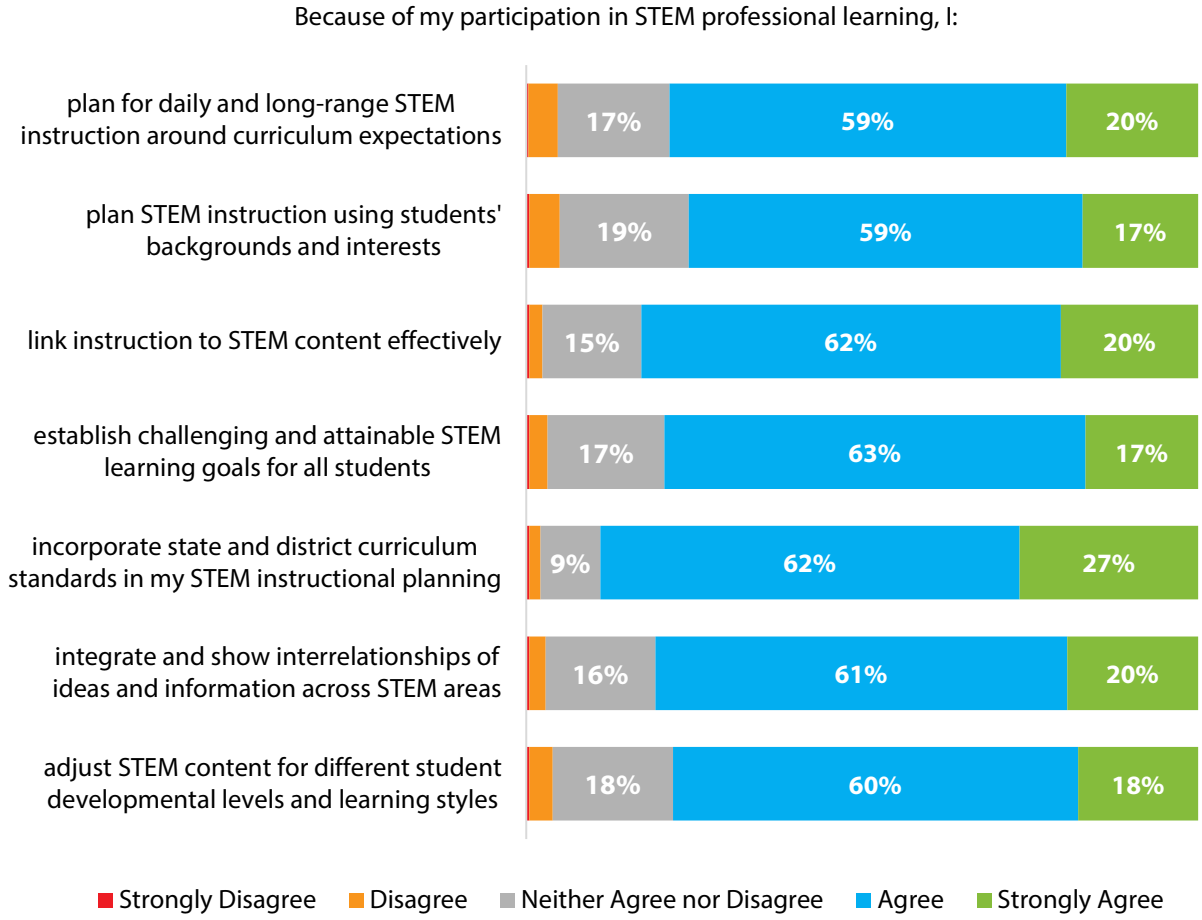
Educators reported success in STEM instructional planning and integration, but struggled to adjust content to meet individual students' learning needs

> "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

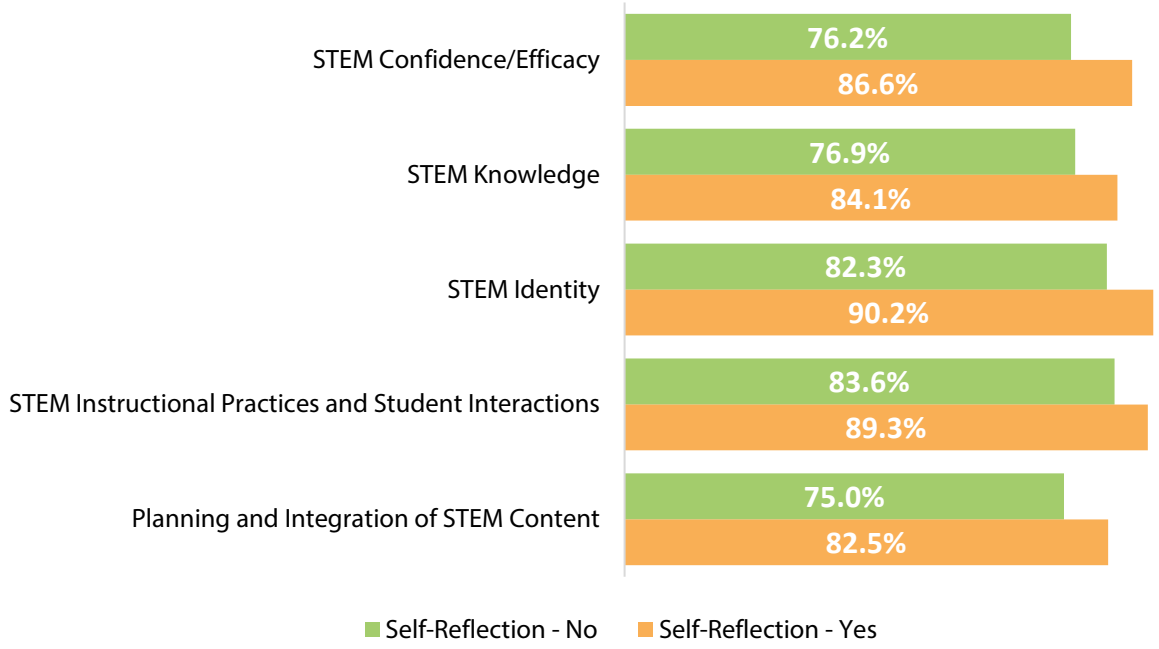
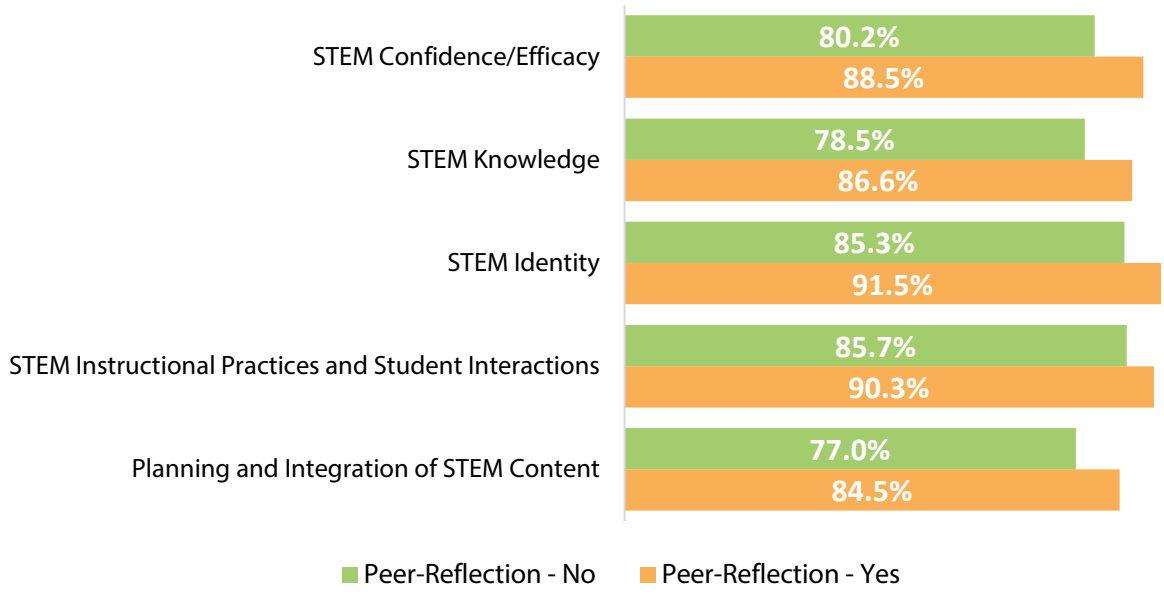


Figure 24. Comparison of Educator Outcomes by Engagement in Video-Based Peer-Reflection



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

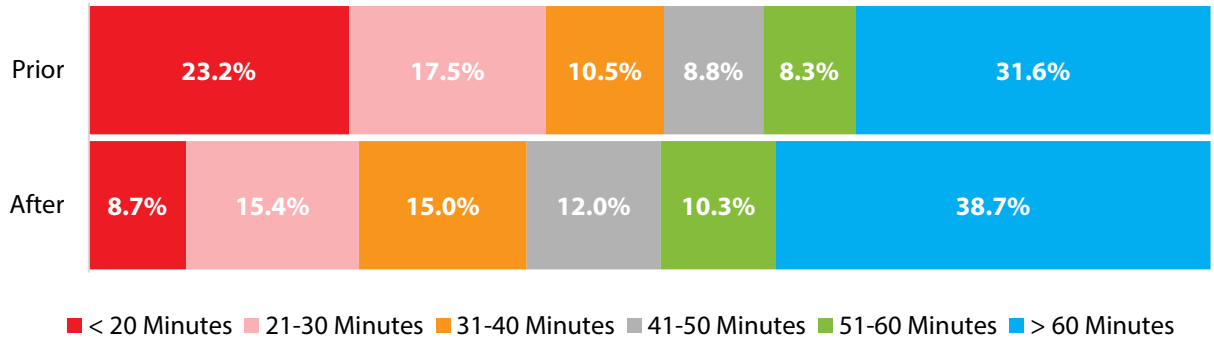
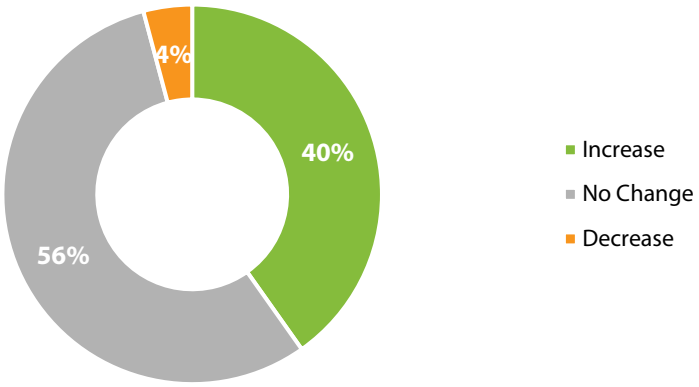


Figure 26 depicts educators' self-reported changes in daily instructional time devoted to STEM instruction since participating in the Professional Learning Grant Program. A large proportion of respondents (40%) indicated that their daily STEM instruction time increased over the course of the 2020-21 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?

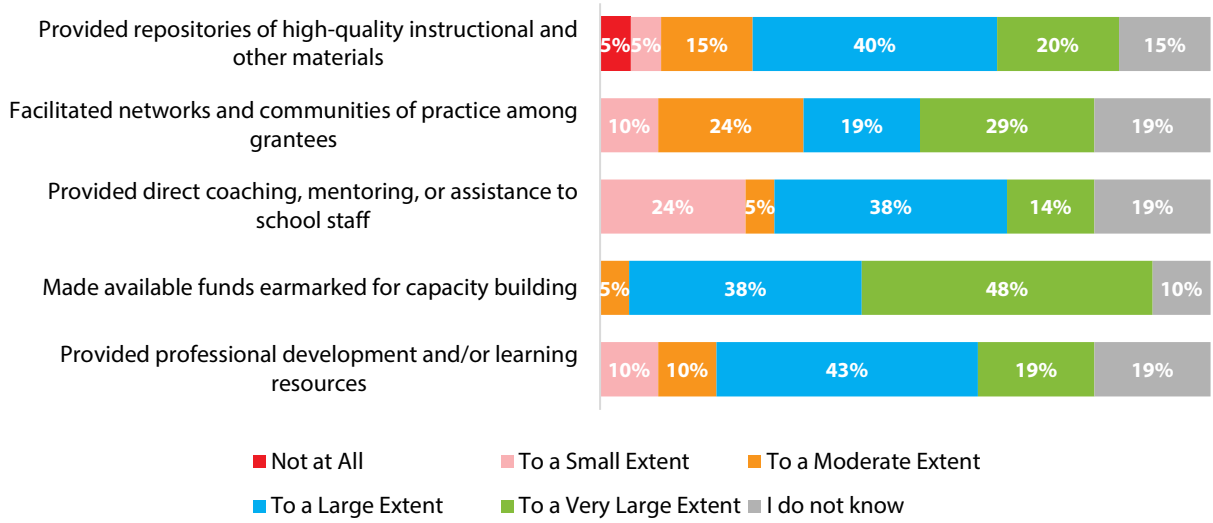
To evaluate the role of the STEM Action Center as an intermediary in facilitating and supporting the Professional Learning Grant Program and educators, we examined UEPC Educator STEM Professional Learning Survey data and interview data. In particular, we considered survey responses provided by administrators 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).

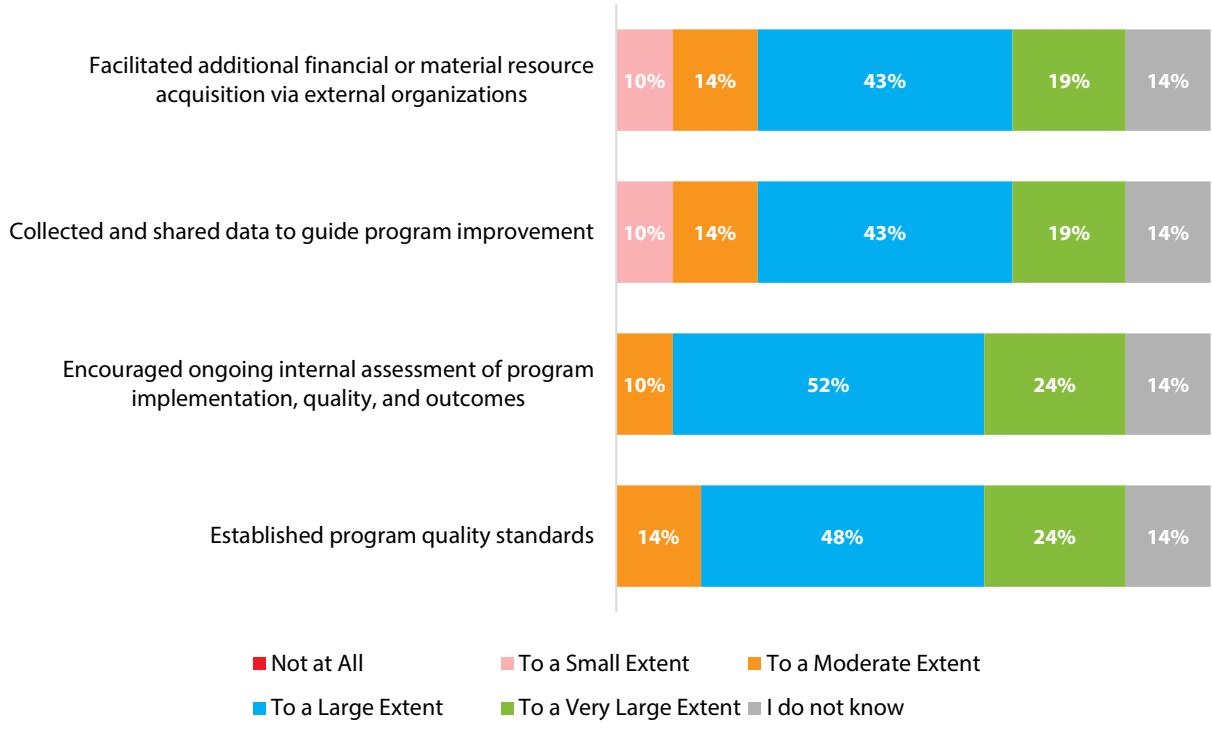
Administrators viewed STEM AC's efforts to support the scaling up of professional learning favorably

> "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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