



Improving Teachers' Instruction

An Evaluation of the Impact of Project EQUIPD— Summary Report

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Introduction

Project EQuIPD—Engaging **Q**uality Instruction through **P**rofessional **D**evelopment—sought to “establish and test for efficacy a professional development model to produce highly qualified teachers in STEM practices for all children, especially for students who are in traditionally underserved schools and districts within the State of Florida” (project proposal). The project did this by providing two years of intensive professional development that helped teachers use system thinking to infuse technology-based inquiry into their regular instructional practices. The project also prepared the teachers, using a train-the-trainer model, so that they could train other teachers and sustain the work moving forward.

The evaluation team collected data on program implementation and used a randomized controlled trial (RCT) to determine the impacts of Project EQuIPD. Key findings from the evaluation include:

This brief provides a summary of key findings from the impact study of Project EQuIPD. Much more specific information on program implementation and on the impact study—including the methodology and detailed impact findings—can be found in the accompanying technical report.

- The program was able to implement all intended activities, modifying some of the delivery methods in response to the pandemic.
- On a survey, treatment teachers reported statistically significantly higher levels of knowledge and higher implementation of EQuIPD instructional practices than control teachers.
- Observations of teachers’ instruction showed no significant overall differences between treatment and control teachers, although treatment teachers scored higher on implementation of inquiry practices than control teachers.
- There was no significant difference in teacher retention or overall attendance between the treatment and control groups.
- There were no significant differences between treatment and control groups on measures of student achievement.

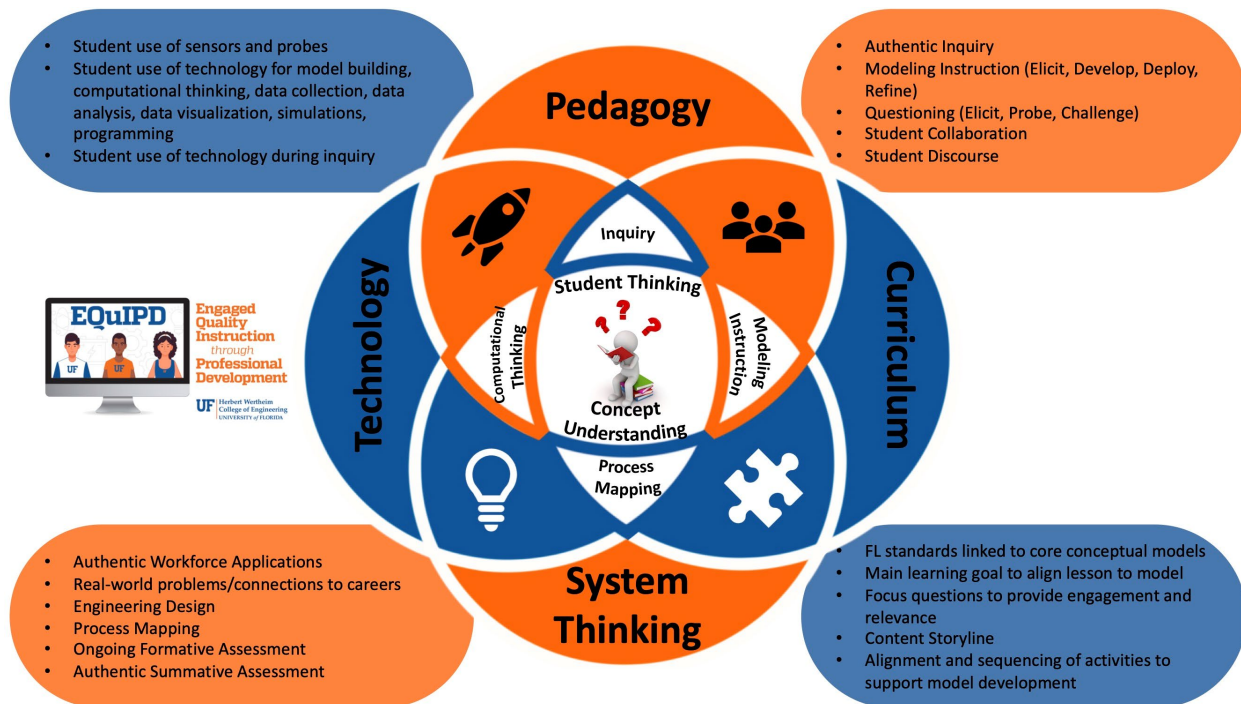
A special note about COVID-19: EQuIPD was being implemented in the core of the pandemic, which required the project to make continual pivots to respond to on-the-ground changes. Additionally, the participating teachers were experiencing substantial stress as they attempted to navigate personal and school challenges while also providing as strong a learning experience as possible for their students. Although EQuIPD did not have all of its desired impacts, it is impressive that the project was able to successfully implement its targeted activities. Given the context, we acknowledge that this evaluation was likely not a fair test of the true impact of EQuIPD; it is possible that, if the pandemic had not happened, the impact findings might have been different.

The EQuIPD Model

Led by the University of Florida, Project EQuIPD was a three-year grant awarded through the U.S. Department of Education’s Supporting Effective Educator Development (SEED) Program. The project was implemented in ten counties in Florida: Hillsborough, Palm Beach, Sarasota, the Heartland Consortium (Hardee, Hendry, Okeechobee, Glades, DeSoto), St. Johns, and Manatee.

The goal of the program was to improve teachers’ content and pedagogical knowledge in four important ways. First, teachers would use a system thinking approach to design inquiry-based lessons such that students were better able to develop conceptual understanding. Second, teachers would embed more technology—such as sensors and probes that were emphasized in the professional development—into their lessons. Third, teachers would increase their use of inquiry-based instruction that used student teams to solve real-world problems. Fourth, teachers would make greater connections to real-world issues and industries throughout their instruction. Figure 1 presents a conceptual overview of the way in which teachers were expected to change their practices.

Figure 1: Project EQuIPD Conceptual Model



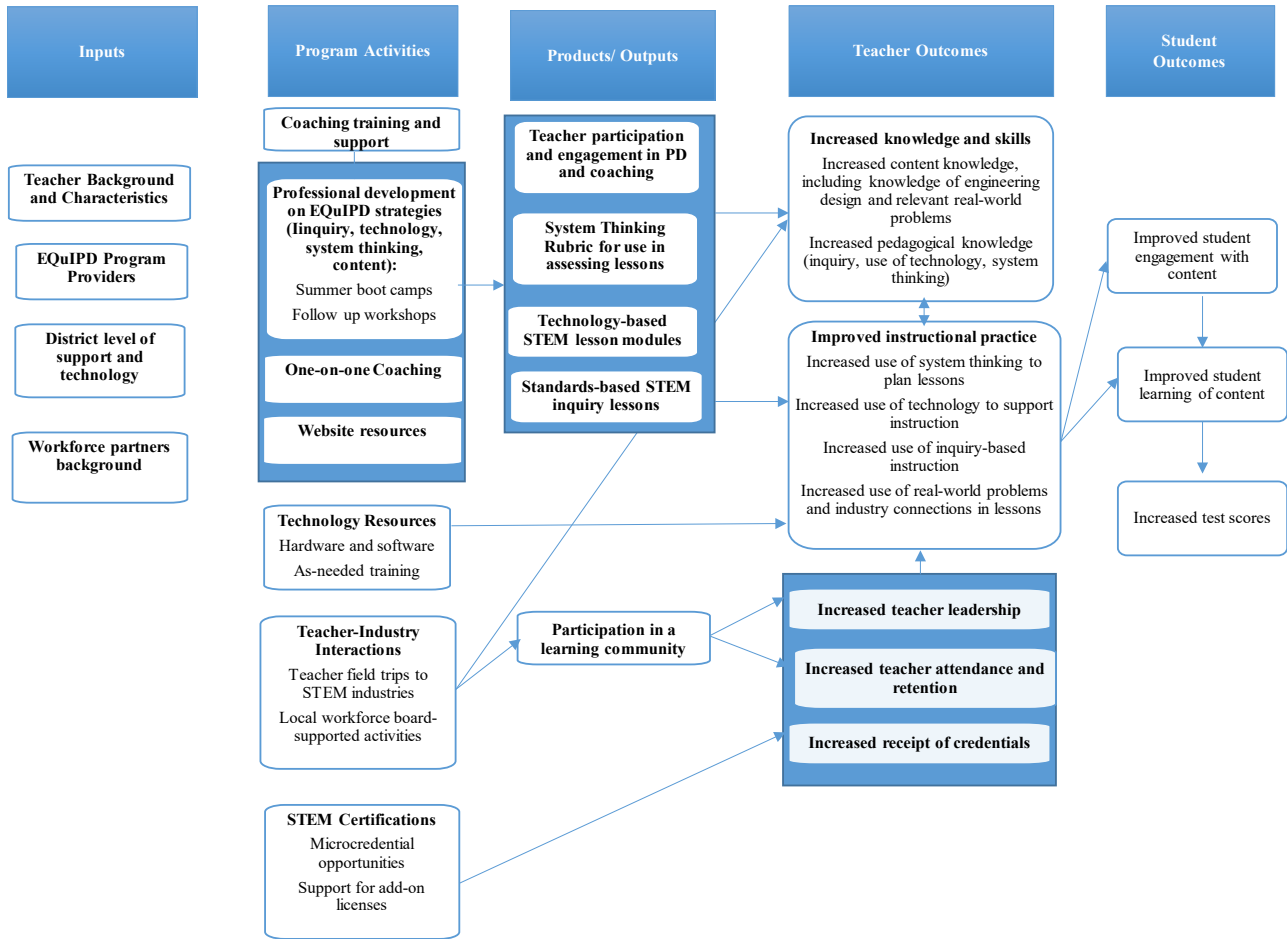
To help teachers change their instructional practice, the program provided the following activities and/or resources:

- Two years of *Summer Bootcamps*, which included five days of intensive training around system thinking, use of technology to support inquiry-based instruction, and concept modeling. A total of 82 teachers completed both Bootcamps.
- *Follow-up workshops* that supported and expanded upon the summer training. A total of four full days of follow-up workshops were provided annually. Seventy-five percent (75%) of active participants finished all four workshops in Year 1 but only 20% completed both the virtual workshops and the required asynchronous activities in Year 2.
- *Online modules and web resources* that included sample lessons and other materials for teachers to use and adapt for use in their classrooms. These were available to teachers through a dedicated Microsoft Teams website.
- *Technology*. The project purchased sensors and probes for teachers and made them available for checkout. The project team also provided training on how to use the software and hardware emphasized by the program.
- *Instructional coaching* to participants. Coaches were expected to provide two coaching visits monthly, and approximately two-thirds of active participants received that level of coaching each year.
- *STEM-oriented field trips* offered to companies that used sensors and probes in their everyday work. In Year 1, the field trips were in person, but shifted to virtual at the end of the year and remained that way for Year 2. A total of 34 virtual field trips were offered in Year 2.
- Establishment of *STEM-oriented industry-school partnerships*. At the project level, the EQuIPD Principal Investigator worked with multiple technology partners. Approximately 40% of treatment teachers who responded to the survey in Year 2 indicated that they had brought in guest speakers from external organizations.
- *Financial and programmatic support for micro-credentials, STEM-related industry credentials, and teacher certifications*. The project supported teachers who wanted to earn additional credentials by both paying any costs for exams and by providing study groups and other support for teachers who were preparing for the credentials.

As described in the above bullets, the program implemented all the expected activities, even in the middle of the pandemic. When schools were closed, the program shifted to providing online supports and also provided supplemental training to help teachers prepare to teach virtually. During summer 2021, participating teachers prepared and provided professional development to control teachers and other teachers in their districts. Fifty-one (51) treatment teachers from eight districts led 95 two-and-a-half-hour sessions between June 1 and July 31, 2021, with 136 teachers attending the sessions.

Figure 2 shows the relationship between the program activities and the project's desired outcomes.

Figure 2. Project EQuIPD Logic Model



Evaluation Methodology

The external evaluation, which was conducted by a team from The SERVE Center at the University of North Carolina at Greensboro, was designed to examine the impact of the project on targeted teacher and student outcomes. The research questions driving the evaluation were:

1. What is the impact of EQuIPD on teacher outcomes including implementation of technology-infused inquiry instructional practices, teacher retention, teacher attendance, and their attainment of credentials?
2. What is the impact of EQuIPD on student achievement?

The methodology used to answer each question is described separately.

Evaluating the Impact on Teachers

The evaluation used an experimental design to assess the impact of EQuIPD. A total of 305 interested and eligible teachers were randomly assigned to either participate in the professional development (n=134) or serve as a control teacher (n=171). Approximately one quarter of treatment and control teachers declined to participate after random assignment but prior to the start of professional development; these teachers were included in the attrition calculations. The specific analytic samples differed by outcome measure, and attrition was calculated separately for each measure. There were three primary sources of data: 1) surveys, 2) classroom observations, and 3) administrative data from the districts.

Survey. The evaluation team used primarily existing and validated scales to develop a survey to measure the knowledge and skills targeted by EQuIPD. The survey was administered at baseline (spring 2019), again at the end of the first year (spring 2020, prior to the pandemic), and then at the end of the second year (spring 2021). Sixty (60) treatment teachers and 86 control teachers responded at baseline and in Year 2, for an overall attrition rate of 52.1% with a 5.5% differential response rate, which is outside of WWC's acceptable bounds of attrition. As a result, we assessed baseline equivalence for reported outcome measures. Baseline equivalence was met on the overall knowledge and overall instructional practice scales and on 10 out of the 12 specific indicators. The evaluation team analyzed differences between treatment and control groups using a regression analysis with an indicator for treatment status; baseline scores were included in the analyses. Because teachers were randomly assigned in waves, the results were weighted by teachers' likelihood of being randomized.

Observations. The evaluation team also observed teachers' instructional practice at baseline (spring 2019) and at the end of Year 2 (spring 2021) using a protocol that was based on the existing and validated *The Electronic Quality of Inquiry Protocol* (Marshall, Horton, Smart, & Llewellyn, 2008). The evaluation team recruited and trained observers who conducted the baseline classroom observations in person. Because of the pandemic, the Year 2 observations had to be virtual. Observers either observed teachers' online lessons (for virtual instruction) or provided teachers with setups of six iPads that were then

used to remotely observe the face-to-face instruction in the classrooms. The sample for the observation analyses consisted of the 145 teachers (63 treatment and 82 control) with complete observations in 2019 and 2021. Overall attrition was 52.5% with 53.0% in the treatment group and 52.0% in the control group, which met WWC expectations for attrition. Interrater reliability was assessed using percentage absolute agreement, which ranged from a low of 51.4% to a high of 81.1% on individual scales. The observations were analyzed using the same approach as the survey.

Administrative data. Districts provided the evaluation team with the employment status and teacher attendance data for all teachers who agreed to participate as either treatment or control teachers. Attrition rates for those analyses met WWC standards for an RCT.

Evaluating the Impact on Students

To look at the impacts on student outcomes, the evaluation team compared test scores for students of the treatment teachers to students of the control teachers in Year 2. Eight districts provided student achievement data for spring 2021 as well as demographic data and baseline achievement data for the students. The evaluation team received student achievement data for a total of 70 treatment and 87 control teachers.

Because teachers were assigned to the intervention prior to the students being assigned to the teachers, the evaluation team assessed the baseline equivalence of the students in the analytic sample for the four outcomes that were examined: 1) a composite reading and math score, 2) reading, 3) math, and 4) science. Differences between the treatment and control groups on all measures were less than 0.13 standard deviations.

In terms of analysis, students in treatment classrooms were compared to students in control classrooms using hierarchical linear modeling (HLM). A benefit of HLM is that it takes into account that students are clustered within schools when estimating program impacts. To improve the statistical precision, the evaluation team included the characteristics of the students themselves in the analyses (e.g., baseline reading test scores, underrepresented-minority status, economically disadvantaged status, gender, special education status).

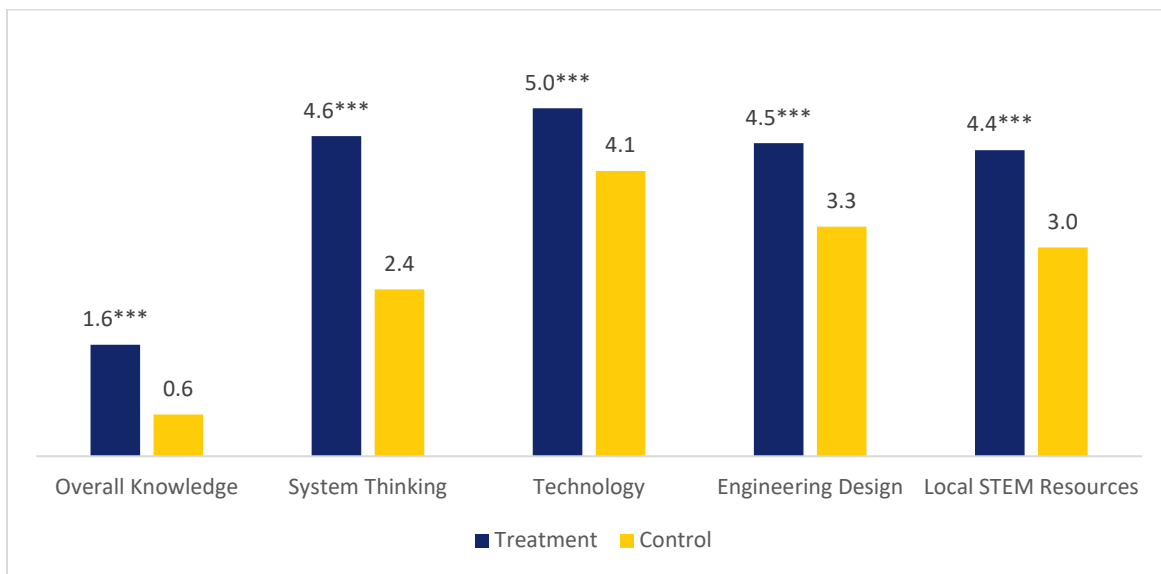
Impacts on Teachers

As described in the proposal, Project EQuIPD was intended to “increase STEM (science, technology, engineering, and math) pedagogical content knowledge of teachers in: System Thinking ... [and] standards-based lesson design incorporating inquiry, computational thinking, technology integration, and engineering design.” As a result, the evaluation measured changes in teachers’ knowledge, their implementation of targeted instructional practices, and teachers’ leadership behaviors.

Impact on Teachers’ Knowledge

The survey included questions about teachers’ level of knowledge of the specific targeted content areas. The evaluation team created an overall measure of teachers’ knowledge by combining results for all the knowledge-related scales. Treatment teachers reported higher levels of overall knowledge than the control teachers, with a very large and statistically significant effect size of 1.6 for Year 2. Additionally, there were large and positive impacts on the four individual knowledge scales (Figure 3), including system thinking, technology, engineering design, and local STEM resources. We also looked at teachers’ comfort with technology, which did not have a significant impact; interviews suggested that this was driven by the fact that teachers were learning new technologies as part of the project.

Figure 3: EQuIPD Teachers Reported Higher Levels of Content Knowledge



Note: All scales were on a five-point scale except for Overall Knowledge. That scale was standardized with a mean of 1.0.
***Statistically significant at $p \leq .001$.

In interviews, teachers reported learning more about technology, concept modeling, and system thinking, all of which helped them with instruction during the pandemic. As one teacher said,

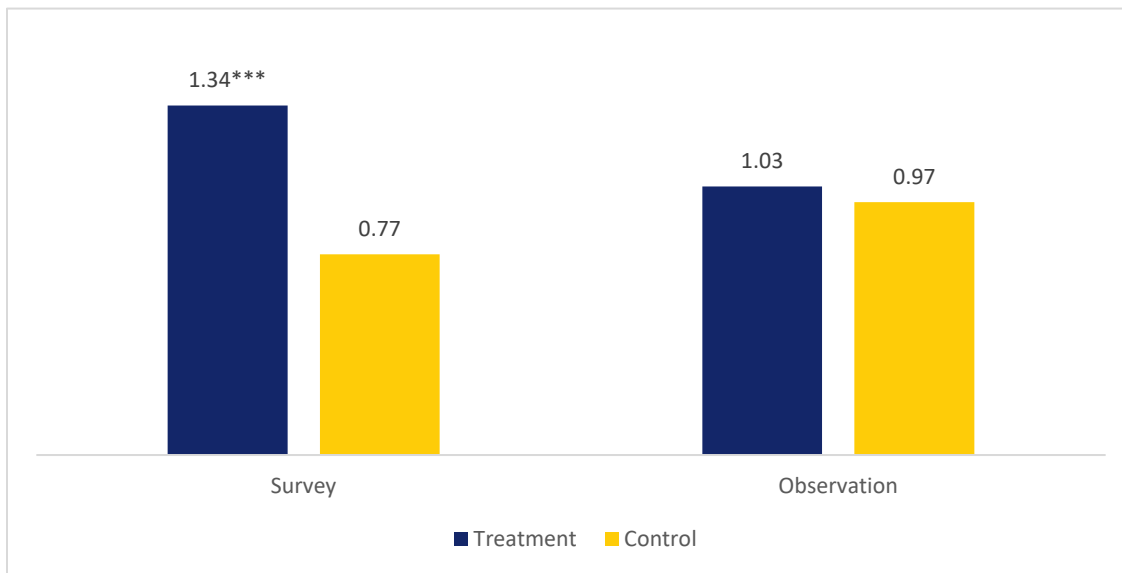
That's what I really leaned on this year, building that conceptual model of the knowledge. ... What do the kids need to know? And kind of start building almost a mental map ... [of] how that knowledge, how the concepts and the vocabulary interact.

Impact on Teachers' Instruction

Changes in teacher knowledge were expected to precede changes in teachers' instructional practice. The project expected teachers to use technology-infused inquiry practices that integrated real-world experiences. The evaluation used three primary sources of data around the implementation of instructional practices: 1) the survey, 2) observations, and 3) interviews with teachers.

Impact on Instruction Overall. The evaluation team developed two primary measures for instructional practice. One was the composite score on the survey and the other was the weighted composite score for the observations. As shown in Figure 4, there were large positive impacts on the instructional strategies scale and no significant impacts on the observation scale.

Figure 4: EQuIPD Teachers had Higher Levels of Instructional Practices on the Survey but not on the Observations



***Statistically significant at $p \leq .001$.

Why were there positive impacts on instructional practices from the surveys and null results from the observations? One obvious difference between the two is that the survey was self-report, and the observations were done by external observers. It is possible that treatment teachers had become familiar with the expectations of the grant and were therefore more likely to report that they were doing activities that were a focus of the grant. The evaluation team tried to minimize that likelihood by including questions where they were simply asked to describe their instructional practices, but it is still possible that treatment teachers were primed to respond in a certain way.

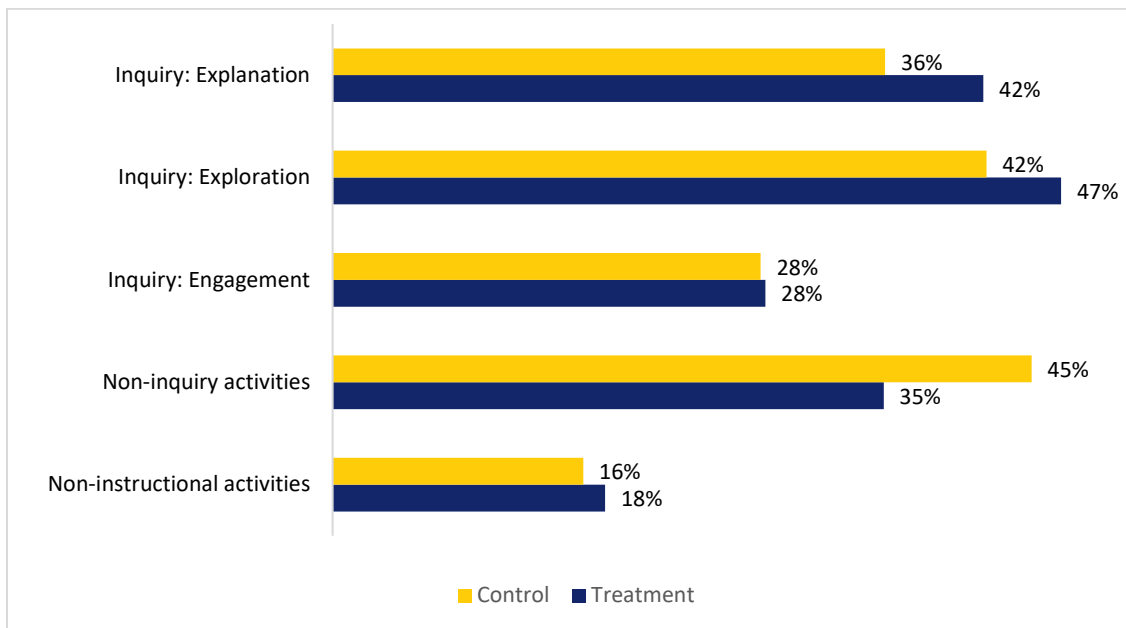
It is important to note that there were positive impacts on the inquiry-related measures of the observation scale (see below). These positive impacts are close to 0.20 standard deviations, which are not large enough to be statistically significant, given our sample size. It is not unexpected that effect sizes would be larger for survey results than observation results, given that teachers might overestimate their implementation of specific strategies.

In interviews, teachers and coaches indicated that a key overall outcome was that teachers were more intentional in planning their lessons.

It has changed the way I think about my lessons. I do think of them more like the model ... what is my end goal? So, I think about my lessons a lot more strategically than I used to.
—EQuIPD Teacher

Implementation of Specific Instructional Practices. The program also explored implementation of different types of instructional practices that were targeted by the grant. Results from the analyses showed that teachers were increasing their implementation of inquiry-related activities. On the survey, treatment teachers reported higher levels of implementation of inquiry practices (a statistically significant effect size of 0.56). On the observations, treatment teachers scored higher on implementation of inquiry activities than control teachers (effect size of 0.20), although the difference was not statistically significant. A descriptive analysis of the observations also showed that treatment teachers spent more time on inquiry-related activities compared to control teachers as shown in Figure 5.

Figure 5: Percent of Time Segments Spent on Different Activities, Observations



Relative to technology use, there was a significant impact on the survey measures (effect size of 0.68) but no difference between the treatment and control groups on the observations. In the interviews, however, teachers and coaches both described using much more technology than

they had in the past. It is possible that the restrictions placed by COVID-19 on students sharing equipment may have limited what teachers could do with technology and that the observation methods may not have captured everything that was happening.

On the survey, treatment teachers reported higher implementation of concept modeling (with effect sizes of 0.55 and 0.60 for the two measures). In interviews, system thinking and concept modeling were frequently mentioned.

Treatment teachers also reported higher use of *real-world problems* (effect sizes of 0.81 and 0.66 on the two survey measures) than control teachers. On the other hand, control teachers scored higher than treatment teachers on the observational measures of real-world problems (effect size of -0.17), although the difference was not statistically significant.

Finally, EQuIPD teachers reported significantly higher levels of implementation of collaboration and group work on the survey (0.42 and 0.54 on the two scales).

Again, there was no significant difference on the observations, although treatment teachers' scores were descriptively higher than control teachers.

I'd say that the biggest thing overall for me would be just the interconnectivity of stuff, building a model that I can attach to another model or building a lesson I can attach to another lesson. But being able to have a little more intentionality to my lessons where one leads into the next, and I can cycle back to the stuff we covered in the previous lesson and bring it forward into this lesson in a meaningful way and build on to it.—EQuIPD Teacher

Impact on Teacher Professional Growth, Retention, and Attendance

As part of the program, teachers were given support to earn new credentials. A descriptive analysis of the survey showed that 60% of treatment teachers reported either earning or working on a credential compared to 50% of control teachers. The program also expected teachers to take on increasing professional responsibility. On the survey, which was administered prior to the summer professional development that teachers offered, treatment teachers reported descriptively higher levels of engagement in professional activities, although the differences were not statistically significant. Project records showed that some of the participating teachers had extensive leadership responsibilities in their school. For example, two of the teachers received grants. One teacher received \$2,000 in Arduino Grove Tech and another teacher was awarded a STEM4All grant, which provided 10 drones to the school.

In interviews, two teachers noted that the impact of preparing and presenting professional development for EQuIPD gave them greater confidence in their ability to train and lead their colleagues. As one teacher explained,

[I had] never put myself out there to be, like, a teacher for teachers. Something about being a teacher for the students, that's one thing. But teaching your peers, that's kind of a whole other level. So, I definitely gained confidence in my ability to do that.

Another expectation of the project was that participating in a high-quality professional development opportunity would keep teachers interested in teaching, thereby increasing the likelihood of remaining in the profession. Analyses of administrative data showed that there was no impact on retention or the number of absences overall. This is not surprising given that the COVID-19 pandemic posed overwhelming challenges for teachers, challenges that would be hard for any professional development program to surmount.

Impact on Student Outcomes

The changes in teachers’ instructional practices were intended to improve student learning and achievement. Results show no impacts on any of the outcomes overall, as shown in Table 1. The differences between the two groups were small, and none of them were statistically significant.

Table 1. Impact on Student Outcomes

Outcome	Treatment		Control		Impact estimate	Effect size	p-value
	N	Adjusted mean (SD)	N	Mean (SD)			
Composite score	5,684	-0.01 (0.91)	6,839	0.01 (0.92)	-0.02	-0.02	0.57
Reading score	5,575	-0.02 (0.96)	6,678	-0.01 (0.99)	-0.01	-0.01	0.69
Math Score	5,337	0.03 (0.96)	6,532	0.04 (0.98)	-0.01	-0.01	0.79
Science Score	1,986	0.01 (1.03)	1,889	-0.04 (0.95)	0.05	0.05	0.20

There were no statistically impacts on any subgroups for the composite, reading, or math scores. There were statistically significant positive impacts on science scores for students who were not economically disadvantaged and who had higher achievement; however, given the number of analyses that the evaluation team ran, it is possible that these differences may be occurring by chance.

The lack of impact is not surprising given that EQUiPD was implemented in the middle of a pandemic, which was accompanied by many changes and stresses including shifts between virtual and in-person instruction. Additionally, the 2020–21 tests were not used for accountability purposes, which might have affected student performance.

Discussion and Lessons Learned

Project EQuIPD provided all the planned professional development activities, even amid the disruptions caused by COVID-19. Teachers participated in one week of a Summer Bootcamp in 2019 and an online Bootcamp in summer 2020. Throughout the two years, the professional development team provided both in person and virtual follow-up workshops. By the end of 2019, all the instructional coaches had been hired and worked with teachers in person and virtually over the next 18 months. The professional development team also provided extensive training on the technologies used in the grant as well as the online technologies that were used when teachers had to make the shift from in-person to virtual instruction. The professional development team provided teachers with opportunities for both in-person and virtual field trips to a range of businesses.

Although not all teachers participated in all activities, teachers, on average, received a substantial amount of support. These supports led to treatment teachers reporting much higher levels of knowledge and implementation of EQuIPD instructional practices than the control teachers, even given all the pandemic-related stressors. Remotely conducted observations also showed that treatment teachers had higher levels of implementation of inquiry-related practices although the differences between treatment and control teachers were not statistically significant, likely an artifact of the sample size. Despite reported changes in teacher instruction, there were no impacts overall on student achievement, an outcome that is not surprising given all the other changes brought on by the pandemic. As noted in the introduction, it is possible that, if it had not been for the pandemic, the evaluation findings could have been different.

Over the course of the project, there were some key lessons learned that are important to consider as people seek to move this work forward and potentially replicate this work.

Lesson #1: Complex interventions such as EQuIPD require very clear connections between the different parts. The EQuIPD model is a complex model with many different parts. Throughout the project, coaches and many teachers noted that it was challenging to understand how all the parts related to each other. The concept of system thinking was a particularly difficult concept for many people to fully operationalize, although many teachers appreciated the more specific application of process mapping. The project created different materials to help teachers make these connections more transparent. Alternately, it may be useful to streamline the discussion of the most important key components of the model to reduce the amount of different language and concepts that teachers encounter.

Lesson #2: Real change requires an intensive, aligned system of supports, but this can be challenging to sustain. Project EQuIPD provided a variety of professional development opportunities including intensive Summer Bootcamps, follow-up workshops, and instructional coaching that were all intended to build upon and reinforce each other. The intensity of the professional development supports does pose challenges for sustainability, given that it is difficult for districts to provide that level of support. The project sought to support sustainability by preparing teachers to share what they had learned with other teachers. While this approach can provide some level of support, teachers, by themselves, will not be able to provide the same intensity of support; this must come from districts.

Lesson #3: Projects need to plan for providing specialized technologies. Another lesson learned was that projects should plan for providing specific technologies, such as the sensors and probes, even if districts indicate that these resources are available. This could be done via a checkout system similar to the one used in EQuIPD.

Lesson #4: Management and monitoring systems are critical. EQuIPD's complexity meant that teachers were involved in many different activities, and coaches provided extensive on-site and virtual training and facilitated many different professional development opportunities for the teachers (e.g., field trips, certifications). Over the course of the project, the professional development team recognized the importance of having clear tracking systems that can be used for project management, monitoring, and evaluation. The lack of systems, particularly for tracking coaches and their work, appears to be a common challenge in educational practice. As the project PI commented, "One of the things, when I look at literature, is almost nobody has these plans for managing coaches, and they don't know what they do." Mid-way through the project, the project PI noted that "creating these kind of tracking systems, in a way, is almost like a side product of the grant." Ensuring that such systems are in place from the beginning would be useful for any kind of professional development project.

Lesson #5: EQuIPD was able to effectively pivot to respond to COVID-19. Project EQuIPD was substantially impacted by the COVID-19 pandemic. Schools were closed, and teachers navigated moving to online instruction. Similarly, the program had to switch from providing in-person professional development to an entirely virtual experience. From the service provision angle, the transition was fairly seamless with workshops, coaching, field trips and other support activities moving online. All planned activities were implemented. Most teachers were fine with the shift to online opportunities as they appreciated the increased flexibility it gave them with scheduling and working with other teachers or accessing resources that might not be in their geographic area. This suggests that online delivery might be a viable option for the EQuIPD services. Offering hybrid options—with some in-person and some online—might be the best way of meeting diverse needs.

Although the program was able to meet service delivery challenges hand on, it is important to recognize that teachers were under tremendous amount of stress, trying to do their best job at teaching in an ever-changing environment accompanied by potential health challenges for

them and their families. This stress likely made it difficult for teachers to fully engage with the program. Additionally, COVID-19 safety protocols meant that it was challenging, if not impossible, to implement some of the targeted instructional practices (e.g., group work and hands-on inquiry activities that involved sharing materials). As such, the 2020–21 school year was a difficult time to assess teachers’ implementation of the targeted instructional strategies. Despite these challenges however, the treatment teachers reported a much higher level of implementation of instructional practices than the control teachers, and the observations provided suggestive evidence that teachers may have modified their inquiry-related instructional practices. All of this suggests that, in a non-pandemic situation, the program is likely to result in substantial changes in practice.

Disclaimers:

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